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ELECTRICAL WORLD

JUL 1932

August 13, 1932
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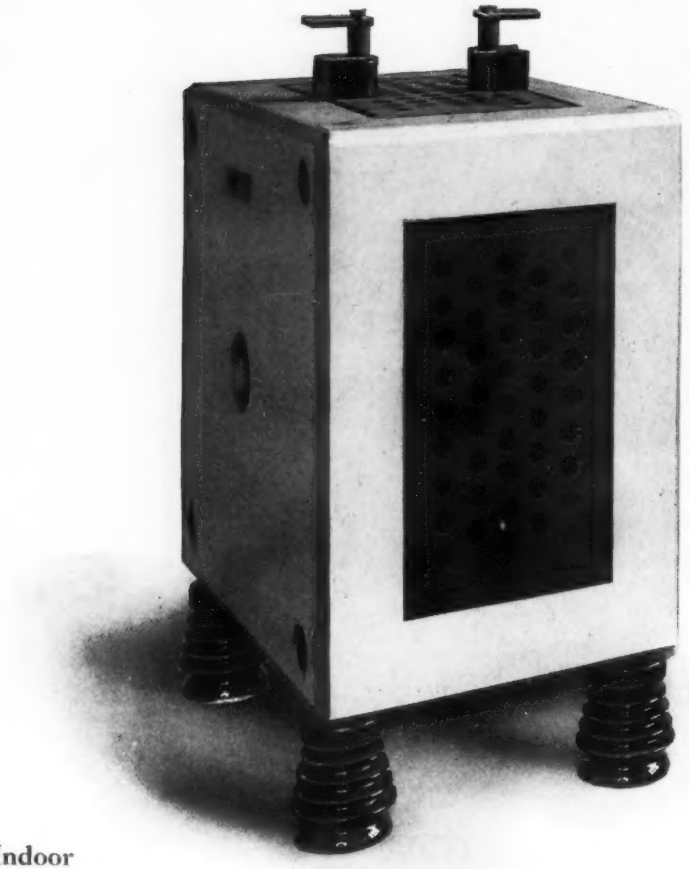

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ELECTRICAL WORLD

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for the Week Ending

August 13, 1932

Penn Central and General G. & E. Receiverships Asked

SECURITY HOLDERS of two Eastern properties have sought receiverships for the organizations in court actions. The Penn Central Light & Power Company, an allegedly wholly owned division of National Electric Power Company and therefore, in turn, related to Middle West Utilities and the Insull situation, is one of the companies. General Gas & Electric Company, part of the Associated System and the controlling interest in the Broad River Power, Florida Public Service and Lexington Water Power companies, is the other.

Improper actions charged

In a suit filed in Pittsburgh federal court this week Arthur T. Downey, a bondholder, asked that receivers be appointed for the Penn Central Light & Power Company. It is alleged that the company, which serves 100 communities in the central part of Pennsylvania, loaned $2,500,000 to the National Electric Power Company, which the directors of the Penn Central "knew, or should have known, that the latter firm was unable to pay," that $4,461,770 was paid to National Electric Power as dividend payments, which sum was taken out of capital, and that the annual financial report of the firm showed certain items as assets, whereas they should have been listed as obligations.

There was no surplus out of which dividends could have been paid, the suit sets forth, and there were circulated accounts and reports "so falsified" as to make it appear that there was a large surplus.

George F. Sargent, W. T. Sackelford and Arthur A. Niessen, representing the holders of 170 shares of 6 per cent preferred class A stock of the General Gas & Electric Corporation, have instituted proceedings in the United States District Court in New York against the Associated Gas & Electric Company, the officers and directors of that company and the General Gas & Electric Corporation, asking the appointment of a receiver for General Gas.

Stockholders' committee formed

A preferred stockholders' protective committee of General Gas is asking deposits of preferred stocks with the Empire Trust Company of New York and the Mercantile Trust Company of Baltimore. Holders of 5 per cent General Gas notes due August 15, 1932, have been offered on an exchange basis 6 per cent notes of the company to mature August 15, 1934. This offer will expire August 14.

This Week

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National Electricity Board Proposed for Britain

The executive committee of the British Labor party has just issued a report on the reorganization of the electricity supply industry, which, along with similar reports on other industrial subjects, will be submitted to the annual conference in October.

The report says that a real start was made with the national planning of the electricity supply industry by the electricity (supply) act of 1926, but much more is needed. On the generating side private plants not subject to control by the Electricity Commission or the Central Electricity Board produce nearly one-third of the total electrical energy generated in Britain, "and there are various distribution disadvantages in the local ownership of selected stations." Substantial progress is being made with co-ordinated generation, but the distributive side of the industry "is in a very much less satisfactory condition."

The report further states that about one-half the charge to consumers represents distribution costs. Authorized distributors will be able to obtain from the national grid electricity in bulk at a low price, but distribution costs will not be directly affected. "Generation is being dealt with on a national scale, but distribution is local, and diversified and inefficient as a whole."

It is proposed that all authorized electricity supply undertakings, the national grid, railway and traction generation, should all be transferred to a National Electricity Board. This board would take the place of the existing Electricity Commission and the Cen-

tral Electricity Board and it would be responsible for the efficient direction and management of the industry subject to any Ministerial or other checks which might be laid down by statute.

The Central Electricity Board, to make the national transmission grid scheme the flexible instrument of production that it was intended to be, has appointed, in accordance with the terms of the 1926 electricity supply act, nine local-grid technical consultative committees of engineers and a national committee to assist the board.

▼

Rock Drains Installed on Saluda Dam

Settlement of earth near the foot of the Saluda Dam, largest earthen dam in the world for hydro-electric development, near Columbia, S. C., following a heavy rain in June, has made necessary the installation of rock drains along the surface of the structure. The cost of the installation was approximately $20,000.

According to officials of the company, some settlement was expected to take place along the toe of the dam, and to a lesser degree along the whole dam, from time to time. After the heavy rain the settlement was found to have taken place at a point about 2,000 ft. from the west end of the dam. Examination showed that the surface water from the rain had drained off rapidly but had penetrated the top layer of earth along the roots of the grass. It was decided to install at the present time rock drains along the surface of the dam to drain off this surface water and to prevent future erosion from rain. The work has been examined and approved by engineers of the United States government.

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Ontario Rehearing Likely Due to Death of Judge

While no decision has actually been reached as yet by the Ontario government as to how the evidence heard by the late Justice Orde in the inquiry into the affairs of the Hydro-Electric Power Commission of Ontario is to be reported upon, there is every possibility, Premier Henry intimated last week, that counsel who appeared during the investigation may be asked, if it is thought necessary to hear them a second time, to present again their arguments on the three phases of the recent probe.

The late Justice Orde's notes, along with the transcript of the evidence taken before him, are available for study and examination by any other Judge whom the Henry government may appoint to bring in a finding on the inquiry. Argument of counsel who appeared for opposition critics of the commission is the only thing, it is understood, which is not available.

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Kansas City Refrigerator Buyers Get 100 Kw.-Hr. Free

Residential customers of the Kansas City Power & Light Company who buy their electric refrigerator between July 14 and August 31 this year get 100 kw.-hr. of electrical energy free of charge under a plan sponsored by the Electric Refrigeration Bureau of Kansas City.

Cost of the free electricity is borne on a 50-50 basis by fifteen co-operating refrigerator distributors and their dealers. With the purchase of any one of fifteen makes of refrigerator the customer receives a current coupon entitling him to 100 kw.-hr.

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Chicago Utility Bonds Reported Oversubscribed

Following the offering to the public on August 3 of an $18,000,000 issue of Commonwealth Edison Company series G, first mortgage 5½ per cent gold bonds due June 1, 1962, at 93 and accrued interest to yield about 6 per cent, bankers reported the issue to be oversubscribed.

On August 9 a $20,000,000 first and refunding issue of 6 per cent gold bonds series C, of Peoples Gas Light & Coke Company was offered at 97 and accrued interest to yield about 6.24 per cent. These bonds are due June 1, 1957. These are two important steps in the clarification of the Insull situation.

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Doniphan Would Reopen Current River Case

The Doniphan Electric Company is seeking a rehearing by the Federal Power Commission on its application for a permit covering the construction of a hydro-electric dam and power house on the Current River at Gartman Rock, 1 mile north of Doniphan, Mo. (ELECTRICAL WORLD, January 16, 1932, page 122.) Preliminary plans for the project are under way. It has been estimated that this development will cost about $4,000,000. The dam would be about 3,000 ft. long and 100 ft. high.

Some time ago the Federal Power Commission granted a preliminary permit to the Current River Power Company, Kansas City, Mo., for construction of a series of hydro-electric dams on the Current River above Doniphan. The three dams planned by the Current River company would generate about 26,000 hp. Their total cost has been estimated at about $8,000,000.

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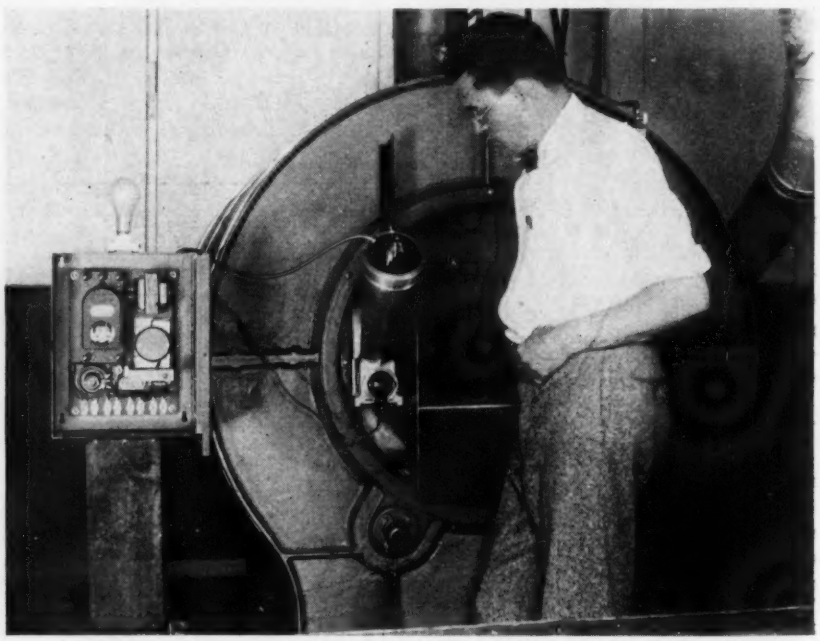
CONTROLLED ROASTER GIVES COFFEE UNIFORMITY



When coffee being roasted in this all-electric device reaches that particular shade of golden brown which indicates that the ideal roasting has been secured a bright light, operated by a Weston photronic cell, flashes on and the supervisor recharges the roaster. The equipment is produced by the McCormick Electric Roaster Sales Corporation of Baltimore, Md.

Western Public Service Defends Scottsbluff Unit

A special election has been called at Scottsbluff, Neb., for September 23 to pass on a proposal to condemn by the power of eminent domain the plant in that city of the Western Public Service Company. Officers of the latter company are threatening legal proceedings to prevent this being done unless the entire system is purchased, asserting that it is a blow aimed at the heart of its widespread power system. Two years ago the voters extended the Scottsbluff franchise 25 years.

Mitchell, Neb., a neighboring town, is to vote October 4 on a similar proposal to take over the local plant of the Western Public Service Company, with which a contract was made several years ago after municipal operation of distribution facilities had proved unsatisfactory. Bayard, another small city in the same North Platte Valley, is asking bids on construction of a plant and has contracted to serve Bridgeport and Minatare, all three being supplied now by the Western Public Service Company.

▼

Unemployed Engineers Aided in Boston

Since January 15 about 300 members of the engineering and architectural professions have been provided with at least part-time employment through the efforts of the Emergency Planning and Research Bureau, Inc., established last winter by the Engineering Societies of Boston and the Boston Society of Architects. The bureau is supported mainly by voluntary contributions of one day's pay per month by members of the above professions and rent-free quarters are provided by the company on two floors of the New Boston Edison building. On August 5 the engineering section listed 248 men under employment, of whom 37 were electrical. About half those employed are engaged in work at the bureau itself and the rest in outside jobs.

The fundamental idea in the work is to avoid competing with outside business organizations and to concentrate activities upon tasks of value to the state and community which have hitherto been left undone in the stress of normal business. The jobs assigned by the bureau cover a wide range, including extensive graphic analyses of economic conditions in individual municipalities, co-operation with city and town planning boards, civic organizations, and governmental bodies and subdivisions. Sales studies include: Retail sales, growth of population and wage earner statistics, data on wired homes, horsepower reported by industries, number of gas and electric consumers in the 80 municipalities of the Boston metropolitan district, and many other items of regional and local survey interest. Cost of government, the relation of rainfall to forest fire incidence, and other topics are being investigated, and a valuable study is being made of the wiring codes and ordinances of Greater Boston municipalities for the Metropolitan Electrical League of Boston in hope of achieving better standardization.

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Rural Electrification Facts Sought in South Carolina

Full information relative to rural electrification in South Carolina is now being sought by the South Carolina Railroad Commission. An order has been issued on all power companies doing business in the state to supply the commission with information. With the order was a questionnaire which is to be filled out, and by means of it the commission will be able to learn definitely the number of customers served on rural electric lines, the miles of lines in operation, the power load and various other technical details. This questionnaire is to be returned within 60 days.

Demand for electric service in the rural sections of South Carolina is rapidly on the increase. The commission has now before it some twenty or more requests for line extensions. It has already issued orders on the Broad River Power Company to show cause before it why power service should not be rendered in two particular sections of its territory.

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Stream Deflectors Ruled No Flow Impairment

Expansion of the municipal plant at Fairbury, Neb., has been made possible by a decision of the state Supreme Court that will permit it to make further use of the waters of the Blue River. The Fairbury Mill & Elevator Company contested the right of the state Department of Public Works to permit the city to put in current deflectors. The Supreme Court says that while the right to use the waters of a natural stream cannot be taken away either by constitution or statute from persons who acquired water rights prior to such enactment, this does not bar the state from permitting such beneficial use as does not impair or interfere with such prior rights. It holds that in this case no such interference has been shown, but that the Department of Public Works cannot determine damages or property rights.

Synthetic Prosperity Is Popular

THAT OLD SPIRIT of speculation, whose demise was less certain than its temporary disappearance, is back again. Here are 5,500,000-share days on the Stock Exchange, with securities leaping up 5-10 points a day. Public confidence as to the immediate future greatly strengthened. Made-to-order prosperity foreseen as producing economic prosperity.

As the result of wide and continued expansion of federal credit, the formation of governmental bodies to forestall actual deflation of home real estate values already reduced by today's replacement costs, speculative pools to force up bond, commodity and stock prices and endless ballyhoo to prove that the turn has come, the state of the public mind is what it is.

No indication of appreciable trade resumption has appeared. Car loadings just about hold their own at levels far below 1931, which was bad enough. Energy production has shown no sustained strength. Automobile production for July is 25 per cent under that for June. General Motors sales are down 57 per cent from a year ago. Class 1 railroads earned but 1.01 per cent in first six months of this year. Business indexes using 1923-25 as a base stand at about 55 per cent, against 75 per cent last year and are at virtually the low point for the depression.

Whatever consolation and joy has reached the eager speculative heart of America is founded, one may surmise, more on hope than on factual evidence of industrial recovery. America is getting a hypodermic — and liking it.

Several Carolina Units Merged with Duke Power

North Carolina Corporation Commission has authorized the Southern Public Utilities Company of Charlotte, operating company under the Duke Power Company, to take over outright five public utilities operating in that state which it formerly had controlled through stock ownership.

The companies are: North Carolina Public Service Company, Caldwell Power Company, Bradley Electric Company, County Service Company and Surry Power Company.

The direct acquisition of the companies adds properties valued at approximately three-quarters of a million dollars to the Southern Public Utilities Company.

The companies are recent acquisitions, and the reasons for not taking them over sooner was given as the desirability of clearing up individual bond issues while they were separate companies. The Southern Public Utilities Company owned all the outstanding capital stock of the companies it is now absorbing.

Coming Meetings

Wisconsin Utilities Association—Commercial section, Eau Claire, Wis., Aug. 25-26. John N. Cadby, 135 W. Wells St., Milwaukee, Wis.

American Institute of Electrical Engineers—Pacific Coast convention, Vancouver, B. C., Aug. 30-Sept. 2. Middle Eastern District Meeting, Baltimore, Md., Oct. 10-13. H. M. Henline, 33 West 39th St., New York.

Pennsylvania Electric Association—Bedford Springs, Pa., Sept. 7-9. H. A. Buch, Telegraph Bldg., Harrisburg.

Rocky Mountain Division, N.E.L.A.—Stanley Hotel, Estes Park, Colo., Sept. 12-14. G. E. Lewis, 367 Gas & Electric Bldg., Denver.

Empire State Gas and Electric Association—Saranac Inn, N. Y., Sept. 22 and 23. C. H. B. Chapin, Grand Central Terminal, New York.

Illuminating Engineering Society—New Ocean House, Swampscott, Mass., Sept. 26-30. E. H. Hobbie, 29 W. 39th St., New York.

National Electrical Wholesalers Association—Hotel Statler, Buffalo, N. Y., Sept. 26-30. E. Donald Tolles, 165 Broadway, New York.

American Welding Society — Buffalo, N. Y., Oct. 3-7. M. M. Kelly, 29 West 39th St., New York.

National Safety Council—Washington, D. C., Oct. 3-7. W. H. Cameron, 20 N. Wacker Drive, Chicago.

Great Lakes Division, N.E.L.A.—French Lick Springs, Ind., Oct. 6-8. T. C. Polk, 20 N. Wacker Drive, Chicago.

Association of Electragists International—Kansas City, Mo., Oct. 10-12. L. W. Davis, 420 Lexington Ave., New York.

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Dallas Investigators Advise Acceptance of Cut

While finding as the result of their investigations that Dallas, Tex., should pay from $600,000 to $850,000 a year less for electric light and power than is now charged by the Dallas Power & Light Company, Burns & McDonnell, valuation engineers of Kansas City, have advised the City Council to accept whatever of immediate relief could be had from the company, subject to a later detailed determination of the justice of existing rates. The report is said to cover every phase of the rate controversy, short of possible findings by an appraisal of the company's property.

It was shown that while production costs in Dallas are lower than in many other cities, operating costs are relatively higher, and that, taken as a whole, existing rates are yielding an "excessive return" to the company. Both privately owned and municipally owned plant figures were cited, with quotations from a number of high court decisions establishing the fairness of varying bases of return.

Reasons for agreeing to the apparent intention of the Council to accept in one form or another a recent offer of the company for a reduction aggregating $250,000 a year were given as the time required and the cost of litigation, though it was pointed out that the city stood to secure a much larger cut in its rates if it should choose to fight the case to conclusion now. The engineers advised that any acceptance of the company offer should be without obligation upon the city not to reopen the question in the future. (ELECTRICAL WORLD, June 4, 1932, page 976.)

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Alabama Governor Seeks Defining of Utility Rights

Electric utilities may be the targets of restrictive legislation or additional tax levies when the Alabama Legislature meets in extra session August 16. The session was called primarily by Governor Miller to seek new sources of taxation. The state is now $20,000,000 in debt and appropriations exceed income. The Governor sponsors an income tax, but others prefer a sales tax, modeled after the Mississippi law.

Governor Miller gave as one reason for calling the Legislature into session the need "to declare the rights, powers and limitations of the holders of various classes of stock of domestic corporations engaged in the business of distributing gas, water and electricity to the public."

Frank P. Morgan, member of the Public Service Commission, has stated: "Additional legislation is needed to define the service commission's power in controlling the shifting of funds and assets from utilities to their holding companies."

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Franchise Taxes Boosted by Nebraska Board

Nebraska state board of equalization has refused, on advice of the Attorney-General, to assess the value of the franchise of the Nebraska Power Company retroactively to 1920. The state did not adopt the policy of valuing franchises for taxation until 1930. The board also refused a request of the Attorney-General to increase the taxable valuations of the Nebraska Power Company, the Iowa-Nebraska Light & Power Company and the Central Power Company, claimed to be paying only upon 55 per cent of their physical value.

Franchise valuations were increased by the board, however, for the Beatrice Power Company, the Interstate Power Company, the Nebraska Light & Power Company, the Nebraska Public Service Company and the Western Public Service Company, and the franchise of the Nebraska Power Company assessed at $1,000,000 and that of the Iowa-Nebraska Light & Power Company at $750,000. Attorneys for the power companies attacked the validity of the law permitting franchises to be taxed, and indicated an appeal would be taken to the courts. They also argued that taxable values of these franchises should be reduced to conform to reduced revenues and lack of adequate net earnings. Last year the companies were taxed $4,802,000 on franchise values distributed among the counties in proportion to assessed valuations of tangible property and thus made subject to local levies averaging 18 mills.

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New York's 10 per Cent Law May Have Further Test

Back of the recent notice of withdrawal of the applications of the New York State Electric Company, a Delaware corporation, to acquire stock of the New York State Gas & Electric Corporation is an involved history of the attempt of the Public Service Commission to enforce its interpretation of the law prohibiting a foreign corporation holding more than 10 per cent of the stock of a local operating utility. The two applications were denied without hearing by the commission in 1928, although the issuance of the stock was authorized, stipulating that the conditions of non-purchase by the Delaware corporation be accepted.

The Appellate Division annulled the refusal as unreasonable and remitted the matter to the commission, which in turn appealed to the Court of Appeals. This the company moved to have dismissed on the ground that the Appellate decision was not final and that the case was in the province of the commission for taking of evidence and issuance of a finding.

The Court of Appeals denied the motion for dismissal, but after argument unanimously dismissed the appeal with the comment that the "commission must still determine whether in this particular case there is reason for withholding the consent." If now the commission refuses to allow the withdrawal of the applications it will, under the court ruling, be required to hold hearings before issuing a new ruling.

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304 Voluntary Cuts in Indiana

Rate reductions totaling more than $1,207,406 for Indiana patrons of electric, gas and water utilities have been approved by the Public Service Commission since January 1, according to a compilation by O. H. Livinghouse, chief of the commission's tariff department. A flood of voluntary cuts in electric rates followed orders of the commission some time ago in which companies were required to establish emergency rates. The commission has approved a total of 304 of these voluntary rate cuts, which lowered the rates paid by consumers $456,496. The commission ordered fourteen cuts in addition, totaling $670,040.

Equity Values Rise with Bond & Share Investments

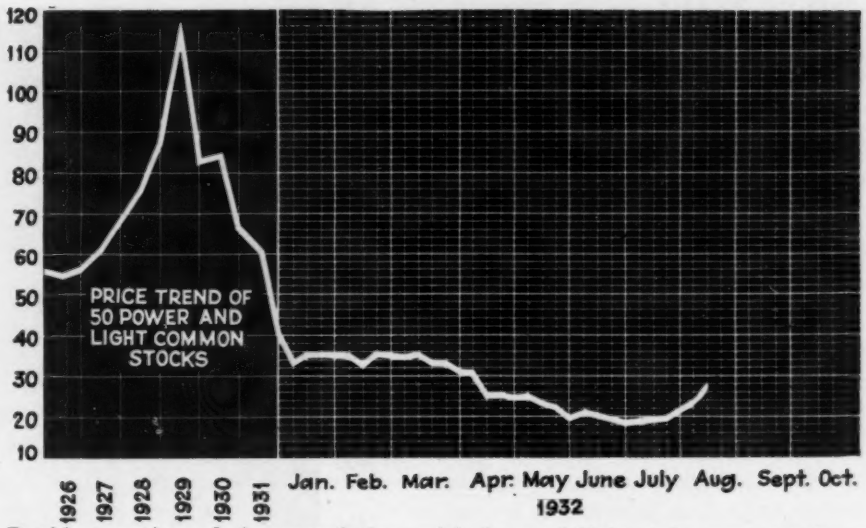
Just how much the market rise can mean to holding and investment companies and their stockholders is indicated in the case of the Electric Bond & Share Company, whose report for the twelve months ended June 30, 1932, shows that the aggregate value of its securities investments then totaled $96,717,000, based upon market quotations as of that date and allowing $20,000,000 for Cuban Electric Company 6 per cent twenty-year debenture bonds, series A, at book value (principal amount), and securities of wholly owned subsidiaries at an arbitrary amount of $2,750,000 (book value $4,784,929). Securities investments are carried on the balance sheet at $452,802,519.

One statement of the report points out to shareholders that the advance in security prices subsequent to June 30 has increased the market value of securities owned by Electric Bond & Share, and as calculated at July 29 the net asset value per share on all outstanding preferred stocks of the company was approximately $164 and the value per share on all outstanding common stock was about $18.50, whereas of June 30 these per share values were $131.95 for preferred and $9.23 for common.

All of the securities now owned by the holding companies in which Electric Bond & Share has its principal investments—American & Foreign Power Company, American Gas & Electric Company, American Power & Light Company, Electric Power & Light Corporation, National Power & Light Company and United Gas Corporation—are held free of pledge. There are no intercompany loans or debts between these holding companies nor do they have any loans from any subsidiary. American Gas & Electric, American Power & Light, Electric Power & Light and National Power & Light have no bank debt. No operating subsidiary owns any securities of any of these holding companies. None of the companies, holding or operating, owns any stock of Electric Bond & Share.

Gross income for the twelve months ended June 30, 1932, amounted to $23,831,214, as compared with $30,484,225 for the twelve months ended March 31, 1932, and net income $17,505,984, against $23,412,235. Operating expenses, excluding taxes, for the twelve months ended June 30 were approximately 29 per cent less than for the twelve months ended June 30, 1931. General reductions were made in the compensation paid members of the organization, compensation to principal officers having been drastically cut.

Heavy Buying Brings Upswing



Rapid extension of the speculative spirit boosted light and power stocks to higher levels along with the general list. Brokers' offices are reported filled throughout the country. New York Exchange has 5,500,000-share day. "Electrical World" average stands at 27.2.

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Utility Bonds Lead in July Financing

New offerings of public utility bonds featured the new financing during the month of July, totaling $93,209,000 out of a grand total of $141,061,000 recorded for all bond issues, including industrial, state and municipal, railroad, etc. In the public utility group light and power offerings played a prominent part. New issues of this type amounted to $77,500,000, as compared with $10,500,000 in the month of June, and $103,000,000 in July, 1931. With the exception of the twenty-five-million-dollar issue of Edison Electric Illuminating Company notes the new financing was of a long-term nature. The average yield was 5.34 per cent.

For the seven-month period ended July 31 new light and power issues totaled $235,130,800, as compared with $1,076,945,000 for the similar period of 1931. (See table below.)

Name of Company	Amount of Issue (Par Value)	Period (Years)	Class	Purpose	Interest Rate	Price	Per Cent Yield
Consolidated Gas Co. of New York	$30,000,000	25	Gold debenture bonds	To discharge obligations on short-term notes	5	94	5.44
Edison Electric Illuminating Co. of Boston	25,000,000	2	Coupon gold notes	To meet maturing notes	5	99.62	5.20
Connecticut Light & Power Co.	7,500,000	30	First and refunding mortgage sinking fund gold bonds, series D	To meet maturing obligations, floating debt and for additions	5	95½	5.30
Union Electric Light & Power Co. (Mo.)	15,000,000	25	General mortgage gold bonds	Additions	5	94	5.44
Total	$77,500,000						

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Few Light and Power Bonds Are in Default

Recent announcements relating to bonds in default as to interest or principal or both show that comparatively few light and power companies are represented on the list. New defaults announced in the past month totaled $299,467,960 and of this sum $8,000,000 represented railroad, $137,762,050 public utility, $109,413,910 industrial and $44,292,000 real estate corporations. The accompanying table shows that of the $137,762,050 recorded for public utility corporations, $90,788,000 represented light and power defaults. It is interesting to note that the Insull units accounted for $65,188,000 of this sum.

Name of Issues	Amount	Date of Default
American Community Power, deb. 5½s (int.)	$5,000,000	July
East Coast Utilities, 2-yr. 6s, 1932 (prin.)	900,000	July
Federal Public Service 3-yr. 6s, 1932 (int. and prin.)	4,500,000	July
2-yr. conv. 6s, 1932 (int. and prin.)	1,500,000	July
Insull Utility Investments, deb. B. 6s (int.)	55,256,000	July
Kentucky Electric Power, 1st 6s (int.	1,100,000	July
National Electric Power, deb. 5s (int.)	9,932,000	July
Texas-Louisiana Power, 1st A 6s (int.)	12,600,000	July
Total	$90,788,000	

The total of all issues in default as of July 15 are: Railroads, $362,434,400: public utilities, including water, gas, railways, etc., $711,393,280; industrials, $717,718,540; real estate, $649,694,200; grand total, $2,441,240,420. The industrials lead the list of defaults, being 29.4 per cent of the grand total; the public utility issues follow with 29.1 per cent; real estate issues represent 26.6 per cent and rails 14.9 per cent.

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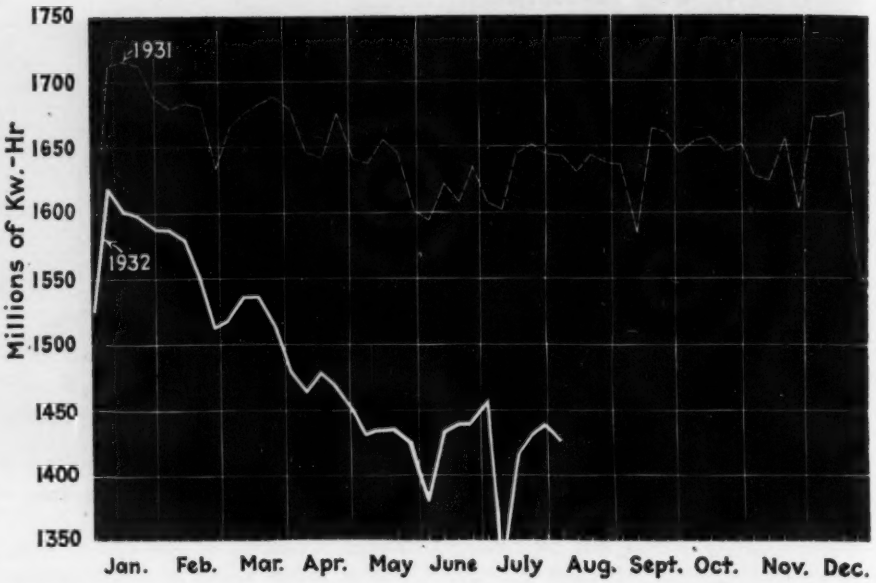
Scenic Issues Introduced in Rainy River Talk

Conservationists have been ruffled because of a report by engineering advisers to the International Joint Commission upholding the technical practicability of plans for converting a chain of lakes in the Rainy River watershed, on the Minnesota-Ontario border, into a series of reservoirs for water-power purposes. The project would, it is said, create additional water storage of about a hundred billion cubic feet, increasing available power at all points by 45,024 hp. at an additional cost of $3,371,000. Congress passed an act in 1930 to head off such a development on the American side of the border except by special congressional authority. Conservationists contended that the power development would damage scenic, recreational and forestry resources of Superior National Forest. Backers of the power project, however, contend that the Shipstead-Newton-Nolan law conflicts with treaties and is invalid.

Little Change in Output



UPWARD-SWEEPING curves, like those depicting stock-market prices in recent weeks, do not yet characterize the operations of the electric light and power industry. Output continues, with moderate weekly fluctuations, on a level 12 or 13 per cent under that of 1931; the ratio has varied little since April.

After climbing for several weeks in July it fell off slightly to 1,426,986,000 kw.-hr. during the first week in August. The decrease, about 1 per cent from the preceding week, leaves the new total 13.1 per cent under last year's corresponding figure. The Central industrial area is off 16.6 per cent, against 15.1 at the end of July; the Pacific Coast 13.0, against 14.7 per cent.

Weekly Output, Millions of Kw.-Hr.

Week Ended	1932	1931	1930	1929
August 6	1,427	1,643	1,692	1,730
July 30	1,440	1,644	1,678	1,725
July 23	1,434	1,651	1,686	1,723
July 16	1,416	1,645	1,667	1,727
July 9	1,342	1,604	1,626	1,712

Per Cent Change from 1931

Region	Week Ended August 6	July 30	July 23
Atlantic Seaboard	— 9.0	— 9.0	— 9.8
New England alone	—10.0	— 9.5	—11.7
Central industrial	—16.6	—15.1	—15.0
Pacific Coast	—13.0	—14.7	—15.9
United States	—13.1	—12.4	—13.1

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Current Earnings Reports of Electric Light and Power Companies

OPERATING COMPANIES

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Alabama Power (Year ended May 31)					
Gross earnings	$17,021,585	$17,922,254	— 5.2	49	47
Net earnings	8,594,258	9,459,974	— 9.1	..	..
Net profit	1,681,074	3,129,488	—46.3	..	..
Birmingham Electric (Year ended May 31)					
Gross earnings	6,827,490	7,822,642	—12.7	75	74
Net earnings	1,704,519	2,063,762	—17.4	..	..
Net profit	583,434	996,251	—41.4	..	..
Consumers Power (Year ended May 31)					
Gross earnings	29,924,576	31,869,197	— 6.1	50	52
Net earnings	14,885,729	15,295,101	— 2.7	..	..
Net profit	6,502,128	7,896,367	—17.6	..	..
Dallas Power & Light* (Year ended May 31)					
Gross earnings	5,324,365	5,404,406	— 1.5	46	48
Net earnings	2,863,972	2,811,239	1.9	..	..
Net profit	1,643,434	1,704,468	— 3.6	..	..
Detroit Edison (Year ended June 30)					
Gross earnings	46,515,514	51,109,080	— 8.9	68	67
Net earnings	14,961,353	17,040,524	—12.2	..	..
Net profit	8,936,383	11,129,862	—19.7	..	..
Georgia Power (Year ended May 31)					
Gross earnings	24,867,440	25,824,141	— 6.8	52	55
Net earnings	11,638,590	11,522,070	1.0	..	..
Net profit	2,657,354	3,280,234	—19.0	..	..
Kansas City Power & Light (Year ended June 30)					
Gross earnings	14,690,025	14,840,530	.....	60	61
Net earnings	5,985,495	5,837,644	.....	..	..
Net profit†	4,374,418	4,286,273	.....	..	..
Philadelphia Electric (Six-mos. ended June 30)					
Gross earnings‡	33,127,870	34,188,820	— 3.1	52	53
Net earnings	15,918,189	15,974,137	— 0.3	..	..
Net profit	10,486,101	10,652,000	— 1.5	..	..

HOLDING COMPANIES

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
American Power & Light & subs. (Year ended May 31)					
Gross earnings	$79,925,455	$85,632,773	— 6.6	52	55
Net earnings	37,971,454	38,858,969	— 2.5	..	..
Net profit	15,756,365	18,366,846	—14.2	..	..
Commonwealth & Southern & subs. (Year ended May 31)					
Gross earnings	122,805,565	135,451,420	— 9.4	53	55
Net earnings	57,543,509	61,279,739	— 6.1	..	..
Net profit	9,615,860	17,007,577	—43.4	..	..
Electric Power & Light & subs. (Year ended May 31)					
Gross earnings	76,698,486	83,992,703	— 8.7	56	57
Net earnings	33,660,845	36,225,516	— 7.1	..	..
Net profit	10,222,240	13,112,933	—22.0	..	..
Engineers Public Service & constr. cos. (Year ended May 31)					
Gross earnings	48,894,057	52,796,970	— 7.4	65	65
Net earnings	17,413,811	17,805,522	— 2.2	..	..
Net profit	3,376,017	4,325,671	—21.9	..	..
National Power & Light & subs. (Year ended May 31)					
Gross earnings	75,209,551	79,016,197	— 4.8	60	62
Net earnings	30,127,270	29,969,169	0.5	..	..
Net profit	11,444,455	12,358,976	— 7.4	..	..

Gross earnings — Gross operating revenue. Net earnings — Earnings after deduction from gross earnings of operating expenses taken to include taxes, depreciation, maintenance, operating, etc. Net profit — Balance available from income for common stock dividends.

*Operating expenses do not include depreciation.
†Balance available for preferred and common dividends.
‡Gross revenue includes non-operating revenue.

Copperweld Obtains Levee Order

U. S. Army Engineers have adopted non-rusting Copperweld wire for revetment fabric in flood control work on the Mississippi River and orders have been placed for this year's requirements. This revetment fabric is used for the permanent reinforcement and tying together of concrete blocks, thus forming articulated concrete mats which serve to prevent the river from eating into the banks, protecting property and maintaining the channel for navigation purposes. Adoption by the U. S. Engineers of this non-rusting wire has followed a study of costs which indicated that considerable economy could be effected by prolonging the useful life of the wire reinforcements in the concrete.

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Railroad Electrification Proceeds in Britain

The Southern Railway of England has just completed the first stage of its scheme for main line electrification with inauguration of service at the end of July between London and Three Bridges. The second stage, which comprises electrification of the line between Three Bridges and Brighton, Reigate and Guildford and Preston Park and Worthing, will, when completed next year, permit the Southern Railway to rank not only as the possessor of the longest electrified route in the United Kingdom but also as the first railroad in the country to adopt main line electrification for passenger traffic.

It is claimed for the Southern Railway that it possesses the most extensive suburban electric railway system in the world, comprising over 800 miles of track, 48 rotary converter substations containing over 200,000 kw. of plant, and about 1,650 electrically operated vehicles. Incidentally, the electrified lines represent over 115,000,000 car-miles, the vehicles carrying about 218,000,000 passengers annually and earning nearly $25,000,000 in receipts. The power required for the operation of the electrical rolling stock amounts to some 326,000,000 kw.-hr. per year.

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Welded Pipe Featured in Ohio Damage Suit

A section of welded pipe, part of a 16-in. gas main installed near the Ohio state office building by the Columbus Gas & Fuel Company, is the center of a $1,100,000 suit filed by the state of Ohio against the company for damages resulting from the explosion which partially wrecked the new building April 14.

The state filed its suit last week, alleging that the gas company was liable for the damages because gas leaking from the main caused the blast. The company was negligent in installing a single pipe without ventilation, instead of a double pipe, as required by its franchise, the petition of the state declared.

The state's suit was preceded by a suit filed by the gas company, seeking to enjoin state officials from preventing the gas company from taking up the pipe, which it claimed it needed for analysis to establish defense in damage suits filed against it by persons injured in the blast, or estates of persons killed. The decision on this suit came two days after the filing of the state's damage suit. Franklin County Judge Henry L. Scarlett held that the gas company should be given possession of the pipe, but the state is to have "full opportunity for inspection of the welding during the tensile-strength tests."

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Chromium Plating Patent Upheld by U. S. Court

Validity of the basic patent of Colin G. Fink, professor of electrochemistry at Columbia University, covering commercial chromium plating, has been sustained by a unanimous decision of the U. S. Circuit Court of Appeals for the second circuit, in which all claims of the inventor to his methods for chromium plating were upheld. The suit, brought by United Chromium, Inc., holder of Dr. Fink's patent, against the International Silver Company was originally heard in the U. S. District Court for Connecticut, and a decision was rendered upholding the patent. From this decision the International Silver Company appealed.

For many years chemists attempted to solve the problem of plating metals with chromium, but without success. Dr. Fink, after making numerous experiments, finally evolved a basic method to plate objects with a uniform and adherent coating of chromium. It was found that the chromium particles could be successfully deposited in a durable coating only in the presence of a catalytic agent in the plating bath.

Proper concentration of this catalyst in the plating bath eliminates erratic and uncertain results in chromium plating.

International Silver Company based its defense upon the research performed by the U. S. Bureau of Standards, Eastman Kodak Company, and Westinghouse Electric & Manufacturing Co. The Court of Appeals held that this work failed to anticipate Fink and that the patent provided the method with which "for the first time the art could turn out chromium plating with certainty."

Major New Construction This Week

TRANSFORMERS and auxiliaries, switching apparatus, transmission and distribution lines and auxiliary power substation and line equipment will be installed by Penn Central Light & Power Company, Altoona, Pa. A $175,000 expansion and improvement program.

For $300,000, Municipal Telephone & Utilities Company, Kansas City, Mo., has contracted to construct city-owned electric light and power plant at Goose Creek, Tex.

High-pressure steam turbine unit, two 500-horsepower high-pressure boilers, switching, distributing and other electrical equipment will be installed by Hercules Powder Company at explosive works, Kenvil, N. J. Estimated cost $125,000.

Bids asked until August 26, by Board of Transportation, New York, N. Y., for furnishing and installing electric power equipment for Houston Street subway line of city-owned rapid transit system.

Wellsville, Ohio, is arranging for fund of $500,000 for construction of a city-owned hydroelectric generating plant at Yellow Creek reservoir site, in conjunction with extensions and improvements in water supply system.

A 24-mile transmission line to cost about $35,000 is planned by Southern Public Utilities Company, Charlotte, N. C., from vicinity of Hickory to Lincolnton, including installation of power substation and switching equipment.

Machine drives, motors and controls, conveying machinery and other electrical equipment will be required by Omaha Packing Company, Chicago, Ill., in connection with rebuilding of meat-packing plant, recently destroyed by fire with loss over $2,000,000.

Two transmission lines, each fifteen miles long, of wood pole construction, one 33 kv. and another 13.2 kv., will be built by New York Power & Light Corp. in Adirondack district of New York. Distribution extensions planned.

Morocco Plans Electrical Outlay

Of a sum of $55,000,000 which will be spent in Morocco during the next six years for public works, nearly 250,000,000 francs has been set aside for the electrification and extension of railways. The new lines will provide for the development of mineral resources. About 354,000,000 francs is provided for the irrigation works as well as to provide cheap electrical power for town lighting and heating and industrial purposes.

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New York Metal Prices

	Aug. 2, 1932 Cents per Pound	Aug. 9, 1932 Cents per Pound
Copper, electrolytic	5.25	5.33
Lead, Am. S. & R. price	2.95	3.10
Antimony	5.00	5.00
Nickel ingot	35.00	35.00
Zinc, spot	2.95	3.10
Tin, Straits	21.50	22.50
Aluminum, 99 per cent.	23.30	23.30

Cuts Rate on Buying Municipal

Illinois Commerce Commission in granting the Illinois Power & Light Corporation permission to purchase the municipal electric properties in Prairie du Rocher ordered the company to reduce the rates for electric service. The purchase price was $15,000, including $6,500 cash and $8,500 in street lighting service over a period of ten years. The company will expend $3,000 for rehabilitation and the construction and operation of a 6,900-volt transmission line from Evansville, Ill. The municipal plant had been charging 14 cents net for all energy used with a $1.50 monthly minimum. The Illinois Power & Light will charge from 5 to 10 cents per kw.-hr. with a minimum of $1 a month.

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Electric Heating of Vatican

Pope Pius XI has decided to heat the Vatican palaces, including his own apartment, by electricity from the new oil-burning electric plant and to enlarge the power house built in the Vatican City two years ago.

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Two Towns to Have Joint Plant

Under a contract just entered into between the City Councils of Goose Creek, Texas, and the neighboring town of Pelley a municipal electric light and power plant will be immediately constructed at Goose Creek at a cost of $300,000, for the purpose of supplying both towns with lights and power. Contract for the construction of the plant has been let. Bonds will be issued and will be accepted by the contracting firm in payment. The bonds are to be retired by money derived from net income from the plant.

▼

Small Illinois Utility Sold

Central Illinois Electric & Gas Company, Rockford, has been authorized by the Illinois Commerce Commission to purchase all property of the Pecatonica Electric Company, the purchasing company to assume all liabilities of the Pecatonica company and to give the Pecatonica company 224 shares of its common capital stock and $45,500 of its first and refunding mortgage gold bonds 6 per cent series due 1952.

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West Palm Beach Plans Boycott

A move to boycott firms furnishing West Palm Beach, Fla., with electricity and telephone service includes the local gas and waterworks companies. Leaders of the organized movement designated last Saturday as "petition day." They called on the public to appear at centrally located places to sign the petitions and hear explanations. Signers of the petitions are said to have expressed their intention of discontinuing use of water, gas, telephone and electric service of the companies unless "excessive rates" were reduced.

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Hubbell Reduces Capital Stock

Harvey Hubbell, Inc., Bridgeport, Conn., manufacturer of electrical equipment, has reduced its capital stock from $1,021,500 to $510,750. Shares of stock of the company were placed on a no-par basis.

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Energy Sales to City Taxable

City Solicitor Fleharty at Omaha has advised the Council that in setltement of a dispute with the Nebraska Power Company over an occupational tax a committee representing that body should be named to confer with officials of the company on amending the tax ordinance. His recommendation is that the 3 per cent tax levied on all sales of current and rental of electrical equipment within the city shall include sales of current to the city, school district and county. The company has been eliminating these sales from its gross receipts because they are not "inhabitants of Omaha," as the ordinance is interpreted. Fleharty advises suit to recover the tax for past years.

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Georgia City Ordinances Invalid

Two ordinances of the city of Homerville, Ga., which had been protested by the Georgia Power Company have been declared invalid by Judge William H. Barrett of the United States court. The first required the Georgia Power Company to place all wires within the fire limits of Homerville underground. The second placed an occupational tax of $500 on the company and a tax of $3 a pole per year on the company's equipment.

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Ohio Electric Rates Protested

Protest has been filed with the Ohio State Utilities Commission by the Farrell-Cheek Steel Foundry Company of Sandusky against the electric rates charged by the Ohio Public Service Company of Cleveland. The Sandusky company charges that the rates are "unjust, unreasonable, in violation of the law and produce to the company a higher return than is justified on the present value of the plant and equipment and on present cost of production, labor and fuel." It is maintained that present rates are 50 per cent higher than in 1918 and 1920 and are based on valuation of property, labor cost and fuel in 1928 and 1929. The commission has been requested to fix a new rate, based on present conditions.

Free Lamps Scored in Detroit

James H. Lee, asistant corporation counsel of Detroit, indicated as the hearing before the Michigan Public Utilities Commission on Detroit's petition for reduced electric rates was adjourned to August 15 that he will attack the system under which the Detroit Edison supplies electric bulbs and other services free to consumers. H. A. Snow, controller for the company, said these services cost it $1,000,000 annually. Mr. Lee said he will show that rates can be reduced substantially if the consumers are compelled to buy their own lamps and other equipment.

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New Industries in Alabama

Since the establishment of a New Industries Division in 1925 by Alabama Power Company 197 new plants have been located in Alabama. These plants represent a capital investment of approximately $70,377,000 and yearly payrolls in normal years of about $21,000,000. Basic facts had to be unearthed regarding sources of supply of raw materials, availability of labor, living costs, operating expense and finally exhaustive studies made of markets for output of the prospective plant. The company has not let up in its activities on account of the depression and since January 1 an average of two prospective industrial investors per week have investigated prospects in the state.

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Return and Base Revised Upward

A five per cent return on a valuation of $235,000 having been declared confiscatory after appeal to the Superior Court, the Connecticut Public Utilities Commission has made a revaluation of the property of the Clinton Electric Light & Power Company. As a result the rate base has now been set at $280,000 and rates calculated to produce a 7 per cent return on this amount have now been decreed. The court also ordered the inclusion of an allowance for going concern value; here the commission allowed $5,000 against the company's claim of $32,992.

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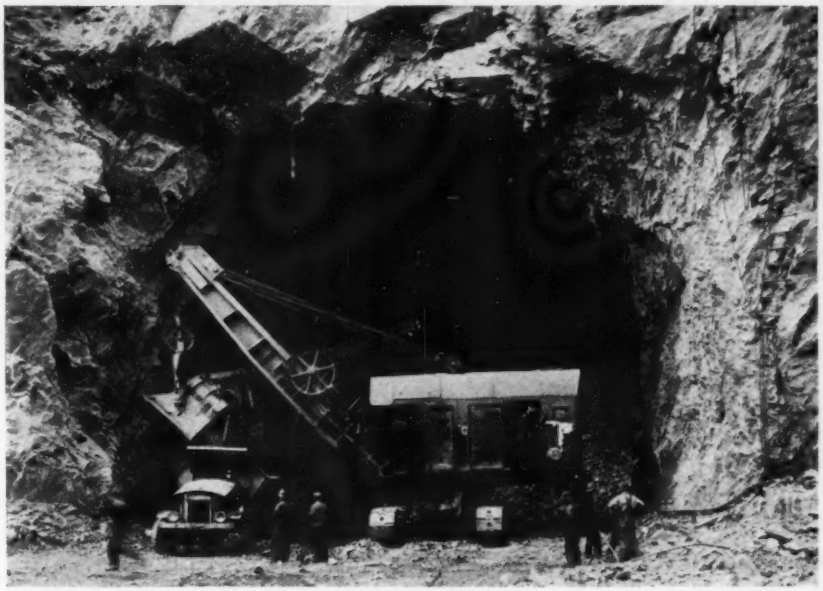
Ohio Rate Cut Offer Withdrawn

Southern Ohio Electric Company has withdrawn its offer to reduce rates in Chillicothe, Ohio, in exchange for a ten-year contract. John B. Poston, general manager of the company, advised city officials that the company's offer of a reduced rate in return for the contract had "merely served to place us under suspicion as to the sincerity of our motives," and hence would be withdrawn. The City Council had asked a reduction, but when the schedule was presented as an ordinance July 25 there was a lack of one vote for approval.

Electric Shovels Excavate at 6 Cents per Cu.Yd.



At Hoover Dam nine Westinghouse equipped electric shovels are digging the four 56-ft. diversion tunnels, whose combined length of 15,909 ft. will sidetrack the Colorado River until the dam is partially in place. Power consumption, based on test data, is about 0.3 kw.-hr. per cu.yd.; electrical and mechanical maintenance on the shovels, including labor and supplies, is less than 6 cents per cu.yd.

About 121 cu.yd. per digging hour has been averaged; a relatively high figure since loaded trucks had to get out of the way before empty ones could back in. Individual records reached 200 cu.yd. per hour and as much as 16,000 cu.yd., solid measurement, were removed from the tunnel in a day.

Power for each shovel is supplied by a 2,300-volt trail cable. A 2,200-volt, 12-hp., 1,750-r.p.m., 3-phase induction motor drives the main four-unit motor-generator set in the rear of the shovel. The 5½-kw. exciter set and other shovel auxiliaries use 440-volt power.

The main hoist is driven by a 75-hp., 475-r.p.m., 230-volt d.-c. series motor. Power is supplied the hoist motor by a 60-kw., 1,750-r.p.m., 250-volt differential compound-wound d.-c. generator. The 28¾-hp., 600-r.p.m., 230-volt swing and thrust shunt wound motors are duplicates electrically and use separately excited fields. Two 22½-kw., 1,750-r.p.m., 250-volt differential compound wound d.-c. generators supply these motors.

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Ice and City Water Cool Detroit Home

Circulating city water in automobile radiators through which air is blown to cool a house in Birmingham, Mich., just halves the amount of ice required for the task. As reported in *Synchroscope*, the Detroit Edison Company organ, the indications are that this home, typical of the class whose occupants could afford to spend $60 to $90 for a summer's comfort, would require about 20 tons of ice for the season, as against 15 tons of coal for winter heating.

A 500-gal. fuel-oil tank, used for ice melting, is located underground adjacent to a driveway for convenient loading and holds 2,000 lb. of ice partially submerged in water. The equipment consists of two cooling coils, one of which uses city water and the other ice water; cold water pump, simple air filter and fan for blowing the cooled air through the ducts to the rooms. Awnings and blinds eliminate one-third the loading as caused by sun shining on the windows and saves 148 lb. of ice per hour. Cooling for 30 hot days appears to require 156 lb. of ice per hour or 1,248 lb. per day.

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High-Speed Elevators for World's Fair Tower?

Suggestions for a steel tower twice as high as the renowned Eiffel Tower in Paris, France, have been submitted to officials of the Chicago 1933 World's Fair by F. A. Randall, engineer.

Plans call for 40-passenger elevators, carrying 4,000 persons an hour, traveling at a rate of 1,600 ft. a minute. Such a steel structure would cost an estimated $3,000,000 and would require 15,000 tons of steel. Financing plans are said to be under consideration. The tower would be 2,063 ft. high. Passengers would be carried to an observation platform 1,933 ft. above the ground. The Eiffel Tower is 984 ft. high; the Empire State Building is 1,250 ft. high.

▼

New York Store Opens the Electric Wonder House

Offered as a home builder's aid toward the selection of those items which make the architecturally venerable charms most modern and livable, John Wanamaker, New York department store, this week opened to the public a full-sized six-room Norman cottage in which electricity is emphasized as the ultra-modern agent. Wonder House includes swinging doors operated in opening and closing by photo-electric cells, air-conditioning, home-automatic sprinkler system, chimes instead of doorbells and all the familiar aids to cooking and cleaning which electrical appliances offer.

Among those present at the opening were George B. Cortelyou, president of Consolidated Gas Company and the National Electric Light Association; Gerard Swope, president of General Electric, and Matthew Woll, vice-president of the American Federation of Labor.

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Constant-Tension Regulator Aids Strip Mill Production

Elimination of the familiar slipping clutch, long used in strip-steel mills for reeling operations, and all the inherent weakness of that purely mechanical expedient, has been accomplished through the development of the constant-tension regulator now used in two steel mills and one strip brass plant.

The constant-tension regulator controls the field current of the reel motor in relation to its armature current in such a way that speed is reduced as torque is increased. Once the desired tension is set it will remain constant for any speed of the material.

In the armature circuit of the reel motor is connected the armature of a specially designed, low-voltage torque motor. This motor has mounted on its shaft a pulley to which is connected a cable passing over an idler pulley and from which is suspended a weight. The control motor is so designed and the weight so selected that when a fixed value of current is passing through the armature of the reel motor the pull of the cable by the control motor and the weight are equal and no motion takes place. Unbalanced conditions, however, will operate a rheostat which alters the field current of the reel motor. The regulator was developed by Reliance Electric & Engineering Company.

EDITORIALS

L.W.W.MORROW
Editor

A Pinchot will rule Pennsylvania

VINDICTIVENESS won over vindication in the successful attempt of Governor Pinchot to pry W. D. B. Ainey loose from his position as chairman of the Pennsylvania Public Service Commission. Physically a wheel-chair invalid, but mentally in full vigor, the Commissioner resigned rather than face the physical ordeal of the hearing to which he had been summoned by the Governor. His denial of the graft charges is as complete as his host of friends could ask for, but there stand the charges and, unfortunately, the opportunity to refute them evidentially will probably not exist.

Judge Ainey is recognized as the dean of the regulatory commissioners. No other one of the group in the 40-odd states could have been selected for a more significant prosecution of the crusade against the whole institution of regulation. For the moment the principle of state regulation of utilities is in the penumbra, under a cloud of suspicion. But in spite of this impugnment of the ethics and efficacy of regulation the institution will survive as the only effective means thus far devised to insure fair rates to the people and free play for individual enterprise in opening technical developments to prompt public use in the utility field.

This case does raise one question that will persist long after its details are forgotten. Must commissioners be recluses, shielded from every unofficial contact with the business world, in order to avert suspicion of fraternizing that can be stretched by vicious inference into collusion? Such a concept goes counter to every modern notion that commissioners should not be cloistered away from the arena of practical economics, delving only in the abstractions of legal tomes. On the contrary, they should be business-minded, with a technical and legal sense of proprieties and potentialities. Pinchot's dismissal of Ainey will make regulators more monastic than ever just at a time when their best-informed talents are needed to prove regulation.

Scope of Bureau of Standards work

THE death of Dr. George K. Burgess, director of the Bureau of Standards, some weeks ago has left a vacancy which has not yet been filled. Appointment to that office comes at a time when much is being said about government intrusion into business as a natural consequence of governmental ambition to be helpful. Some reflections on this tendency at the bureau are therefore justifiable on an occasion when a new head may shape new policies to meet new conditions.

A high degree of reliance has been and always will be placed on the precision standardization work of the bureau in so far as it is confined to the maintenance of the fundamental electrical standards and the perfection of the technique of making the refined measurements. This is the chief reason for the bureau to exist. But in the last decade it has also initiated standardization moves in the fields of technical practice and commercial exploitation of technical processes. Many studies started during the war have been continued, to the benefit principally of smaller industries not having industrial research laboratories of their own. In the field of practice it has taken the lead in sponsoring codes such as the National Electrical Safety Code and others.

All these things have been undertaken in good

faith, but the new temper toward tax-supported governmental agencies that duplicate and intrude upon the province of private business raises the question how much of this activity should be continued and how much of it expanded. The feeling that commercial standardization and research could as well be done in industrial and university laboratories and by the semi-technical trade associations as at the government laboratory is something that the new director will have to reckon with in adopting the program for the immediate future.

In many respects the groundwork for action has been laid by the bureau. Industry knows how to use the American Standards Association to effect the simplification and standardization so essential to economical, orderly and profitable rendition of service to the consuming public. To a considerable extent these new tools can supplant the efforts which the bureau staff felt were necessary in their absence.

Regain discontinued services

SOME customers here and there have had their electric service discontinued. These users will all be back on the lines again, for no reasonable person today questions the utter superiority of the electric way over those which it has so easily supplanted. But the restoration of these services is a bit of a task that utility employees can perform and an organized effort to do this should have and will have rich rewards in new insight to consumer psychology.

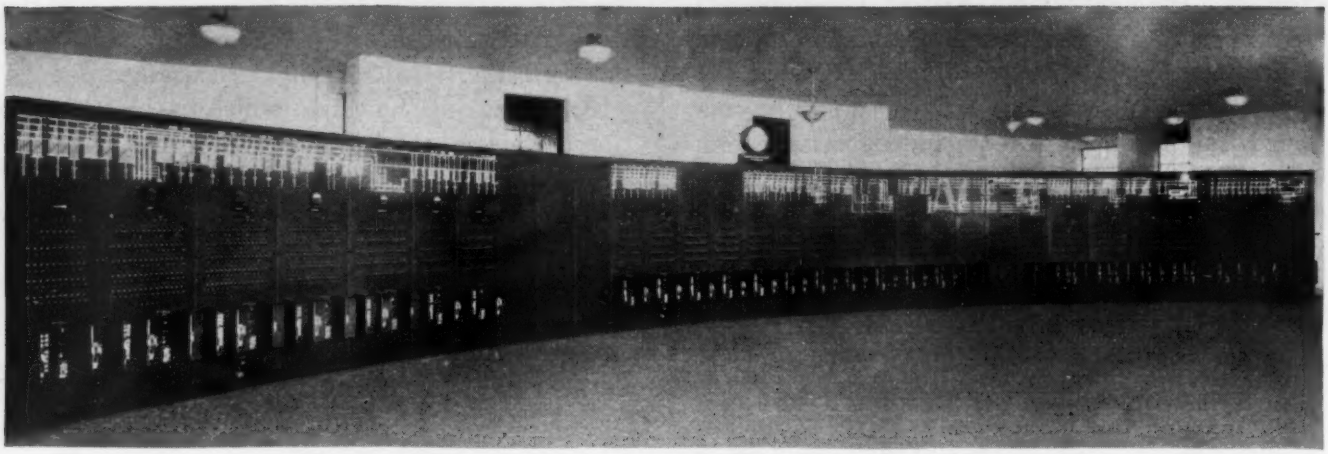
How would it do if companies supplied their employees with a list of the cut-offs, let them pick those they know and then gave them a free hand to induce a reconnection without waiting for the certain eventuality of a voluntary resumption? One company is offering a one dollar commission for every restored service. That dollar bonus is a cheap and legitimate way of accomplishing several things. It gives employees a first-hand contact with the personal problems of depression victims and with the personal vagaries of those with anti-corporate sentiments. It constitutes one more step in humanizing the dealings of the company with its regiments of patrons and its platoons of workers. It does it under conditions far more instructive than merely building load with existing customers in easy times. Also it gives the staff an incentive to build revenues back to the level where pressure of economy will no longer threaten security of jobs and of earnings.

Any company, however, which has a reconnection charge should find a way to waive or reduce it as part of any such program, otherwise the commission to the employee might be viewed by the reacquired customer as something he himself was paying for the privilege of getting back into the electrical fold. It will pay to study these possibilities on many properties at this time.

Fill gaps in system planning

EARLY consideration should be given to the completion of system planning developments in view of the improvement in business sentiment throughout the country. Such work is in a sense perpetual, but the rounding out of projected betterment plans to meet any likely demands for expansion should not be delayed. On many properties considerable time will be required to take out the slack in plant capacity now available and here no immediate outlays on a large scale will be in sight for months. The margin of reserves above load requirements is smaller in other localities, however, and a clear understanding of available plant in the broadest sense is essential to making required moves in ample time and with financial economy.

Confidence grows like a rolling snowball once it gets a fair start. Progressive utilities are watching load changes intently, and if an accelerating demand for industrial power over wide areas should rapidly develop, excess plant capacity, including lines and substations, may be absorbed swiftly over a period of a few months. The domestic load grows apace and nothing like static conditions can safely be assumed in the relation of plant capacity to approaching business. Thoughts of a power shortage are remote today, but when the time for plant expansion through additions or interconnection arrives there must be no needless delay on account of inadequate planning. The time is ripe to complete intersystem and intracompany engineering conferences and studies looking toward the first moves to be made when load developments announce the necessity of early action.



Entire track-feeder system is controlled and supervised from this board

World's Largest Supervisory System for N. Y. Subway

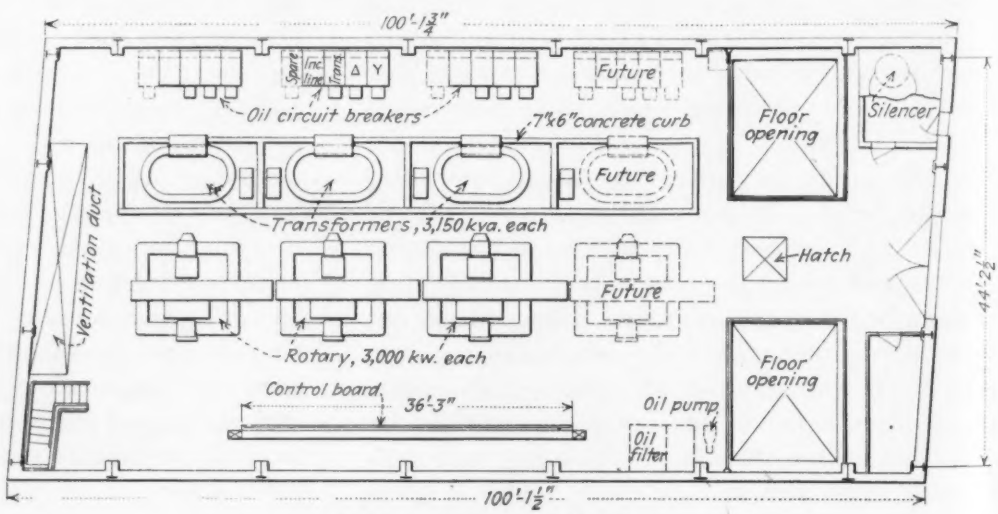
By F. E. JAQUAY and L. D. WHITE
Switchgear Engineering Department
General Electric Company, Philadelphia

WHEN New York City's Eighth Avenue subway is placed in operation its power supply will be controlled by the largest supervisory system now in existence. This system, which is of the synchronous selector type, will permit supervision over 89 substations containing, in the aggregate, 24 synchronous converters, 99 mercury-arc rectifiers, 202 ventilating fans and 817 automatic direct-current reclosing feeders and track breakers. In addition to its control and indication features it also provides the latest in telemetering facilities. Before going into the features of this modern control scheme, which was chosen on account of its high speed of operation, reliability, simplicity, low maintenance and ease of operation, a brief explanation of the size of the project is necessary for a proper understanding of the probluems involved in the control installation .

The new subway, in addition to extending the full length of Manhattan Island, reaches across the East River to the Borough of Queens from the midtown district and to Brooklyn from lower Manhattan. At West 150th Street, Manhattan, an extension runs into the Bronx, terminating at Mosholu Parkway. There are two lines under the East River from lower Manhattan, one of which extends toward Coney Island and the other along Fulton Street, Brooklyn, with branches, one of which will meet the Borough of Queens extension mentioned previously.

Both synchronous converters and mercury-arc rectifiers are used for supplying d.c. to the third rail.

Load Dispatcher's Office—The load dispatcher's office is situated at 53d Street, New York, between Sixth and Seventh Avenues. From this point supervision is exercised over all substations. Here the load dispatcher, by means of the supervisory system, can start and stop the machines in the various substations, release for automatic operation or lock out the d.c. feeders, start and stop the ventilating fans and open or close the series track breakers.



Typical converter substation

Control of the entire track feeder system is centered on the supervisory board in this office. The board is composed of panels corresponding to the various zones in which the single-unit rectifier substations and all feeder breakers are located, and named accordingly. To assist in the proper distribution of energy to all feeders, a complete track layout is outlined on the dispatcher's board above the control switches. When full operation of the system begins three operators' desks will be located in front of this board, the left section of which covers the Borough of Queens, the center section Brooklyn and the right-hand section the Boroughs of Manhattan and the Bronx.

Control of all substations containing more than two units is exercised from the machine panels. This board is located in the same room with the track-feeder board, with ample space at either end for the addition of future panels. By means of rectified-current telemetering, indicating instruments on the control panels show the load on the substations. A totalizing instrument shows total load for multiple-unit stations.

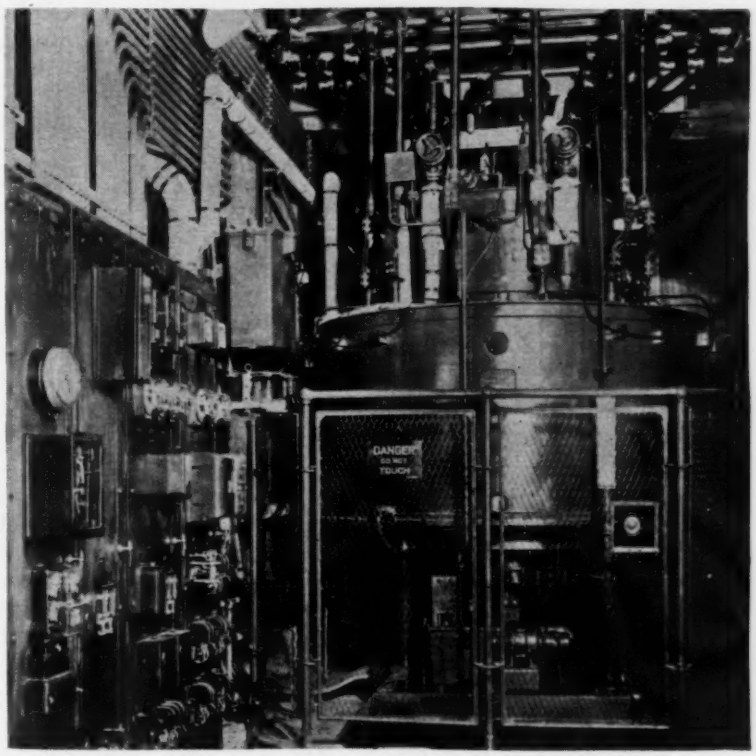
Sources of Power—Power for operation of the supervisory equipment is obtained from 125-volt storage batteries. Power for controlling the substation equipment is obtained from 208/120-volt transformer secondaries supplied from 13,500-volt and 27,000-volt networks and from local 125-volt batteries.

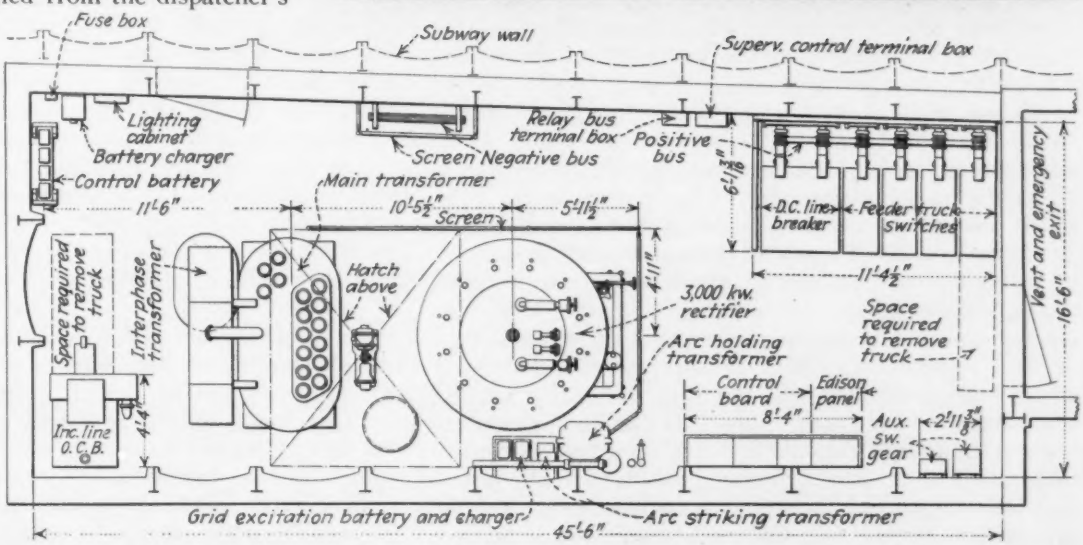
Power distributed by the substations is obtained from the United Electric Light & Power Company at 13,500 volts in Manhattan and the Bronx and at 27,000 volts from the Brooklyn Edison Company in Brooklyn. In the Borough of Queens power will be obtained at 27,000 volts from the New York & Queens Electric Light & Power Company. A unique feature of the a.c. power supply is the provisions for an independent feeder connecting each machine directly to the high-tension network.

The substations, most of which are located underground, are placed at frequent intervals, some operating as single units and a few containing from two to four units. Except for an ulimate of ten 4,000-kw. synchronous converters, the machines are rated at 3,000 kw. and all deliver power to the third rail at 625 volts. The track breakers controlled from the dispatcher's office are connected between the station feeders and the third rail to protect the feeder cables where these are very long. All feeders are of 3,000 amp. capacity and for the greater part are protected by high-speed circuit breakers.

Method of Control—The load dispatcher may, at will, either release a multiple-unit substation for independent automatic operation or he may place it directly under his control, the former condition being indicated by a red lamp for each unit on the supervisory board and the latter condition by a green lamp. The dispatcher can also determine from a lamp indication the condition of the a.c. line at the substation so that he will attempt to start the machines only when a live-line indication is given. To give a conception of the manner in which the control system operates, the method of starting rectifier and converter substations will be outlined.

To start a rectifier substation the dispacher operates the corresponding key unit on the machine supervisory control board. The rectifier being in proper condition to start with the a.c. line energized, the master contactor





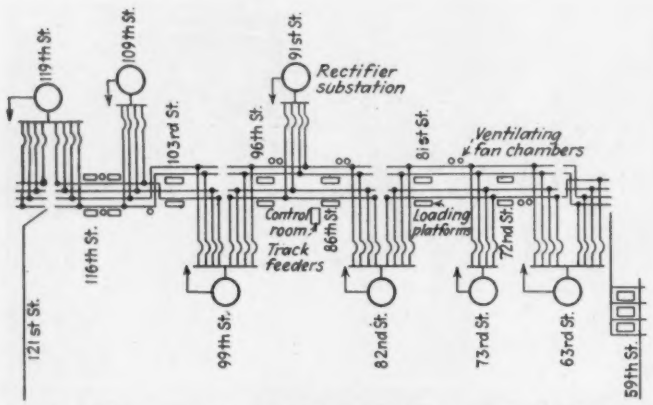
One of the mercury-arc rectifier substations

This substation is underground and required a compact arrangement aided by the use of cubicles for control equipment. The breaker cubicles, not shown, are of the removable truck type and are automatic reclosing.

closes, causing the starting anode to be lowered into the mercury and strike an arc. An excitation relay indicates that the arc is established and permits the closing of the a.c. line breaker. This is followed by the closing of the d.c. line breaker connecting the rectifier to the d.c. bus. An indication is sent back to the dispatcher's office showing that the machine is ready to carry load.

To start a converter station the dispatcher operates the corresponding station key unit and thus actuates a series of devices which complete the a.c. line connection and start the machine. The operating sequence is completed in the usual manner and, as before, the dispatcher receives visual indication that the machine is connected to the d.c. bus.

With the substations operating independently the dispatcher has indications of the running or shut-down condition of the units. In the multiple-unit stations the first machine will be started by the dispatcher, the remaining units being load responsive in a predetermined



One of the zones into which electrical system is divided

sequence. If one unit is operating and an increase in load beyond its capacity occurs a second unit will start and take load automatically. The latter will shut down when the heavier load demand ceases. The starting sequence may be changed by the inspector on his visit to the substation.

Control Rooms—The entire electrical system is divided for convenience into zones, each containing several substations and one control room. The control rooms, of which there are eighteen—one for each zone—act as a connecting link between the dispatcher's office and the track feeders. In zones where multiple-unit substations are located the control rooms are made a part of the substation proper; otherwise they are separate rooms. In all cases they contain the supervisory relays which are actuated by the dispatcher in operating feeder breakers in the immediate vicinity of the control room. The alarm bell panels are also located in the control rooms.

Alarm System—To protect train crews and passengers in case of trouble a special alarm system is installed through the subway. At frequent intervals along the subway tracks it is possible to actuate a fire alarm type of box, which operates the supervisory master-trip circuit to immediately "kill" the third rail in that vicinity and start the ventilating fans. When this procedure takes place a large alarm bell rings in the nearest control room, indicating which feeder has been disconnected. The load dispatcher also receives an indication over the supervisory system that the track feeders have opened. A standard fire alarm printing machine in the dispatcher's office prints on a tape the same impulses that operate the bell in the control room, giving the dispatcher double indication of the trouble. These feeders will not reclose automatically until released by the load dispatcher after the local conditions have been investigated.

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Aluminum as a Reflector of Ultraviolet Radiation

By M. LUCKIESH

Director Lighting Research Laboratory, General Electric Company, Cleveland, Ohio

Oxidized aluminum provides an efficient reflector of ultraviolet radiation. Various solutions are available for etching aluminum, but the reflection factors for light and ultraviolet, respectively, do not vary in the same degree when different etching methods are used. Inasmuch as the reflection of ultraviolet radiation is increasing in importance as the use of sunlamps and of dual-purpose light increases, a study of the results of various etching methods is important.

It was found that the reflection factor for ultraviolet radiation ($\lambda 2967$) could be raised above 80 per cent. This approaches the reflection factors of the best specimens for light, which were found to be from 82 to 87 per cent. The ultraviolet reflection factor seems to depend upon the specimen of aluminum and its surface treatment.

Three methods of etching were studied which yield high reflection factors for light and for ultraviolet radiation. One of these methods involved etching less than five minutes. The aluminum is etched by immersion in a solution containing 5 per cent sodium hydroxide, 4 per cent sodium fluoride and 91 per cent water. This solution is used at a temperature of 90 deg. C. and the article is immersed for a sufficient length of time to produce the desired etch. It is then removed, washed in warm water and immersed for 30 to 40 seconds in a solution composed of equal volumes of concentrated nitric acid and water. This solution is kept at room temperature and immersion is for the purpose of removing any black film remaining from the first treatment. After removal from this solution it is washed in water and, if any film is adherent, it is removed by wiping with a wet cotton cloth. The degree of diffusion is determined by the time of immersion in the etching solution.

Six specimens of aluminum, etched by the above method, were found to have diffuse reflection factors for light of 82 to 84 per cent. Diffuse spectral measurements of one specimen for ultraviolet gave the following results: $\lambda 3663$, 85 per cent; $\lambda 3132$, 81 per cent; $\lambda 2654$, 77 per cent.

Etched aluminum has higher reflection factors for light and ultraviolet than the unetched material. For example, one specimen having a high gloss when it came from the mill had a diffuse reflection factor of 64 per cent for light. Etched specimens of the same material had light reflection factors of 84 to 86 per cent. Etching approximately doubled the reflection factor of the former specimen for ultraviolet radiation of $\lambda 3000$.

35,590,072 Kw. in Public Utilities, All but 6 per Cent in Central Stations

INSTALLED capacity in public utility power plants increased from 34,263,944 kw. at the end of 1930 to 35,590,072 kw. at the end of 1931. The change was equivalent to 4 per cent. Of the aggregate capacity, 94 per cent, 33,483,821 kw. at the end of 1931, was in central stations for electric light and power. Meanwhile for the second consecutive year the output fell off; it was 91,729,000,000 kw.-hr. in 1931, whereas in the year before it was 95,936,000,000 kw.-hr.

Summarizing its detailed monthly statistics on the production of energy and consumption of fuels, which are now republished with final revisions, the United States Geological Survey has issued a report covering operations during 1931, from which the accompanying tables are abstracted.

The Survey's monthly figures are based on reports of the operation of about 3,900 power plants which generate electricity for public use. The net output of the following types of plants is included in these reports: Central stations, both commercial and municipal, electric railway plants, plants operated by steam railroads generating electricity for traction, Bureau of Reclamation plants, public works plants, and that part of the production of electricity by manufacturing plants which is sold. Table I gives the number, capacity and output of each of these types at the end of 1931.

For comparison Table II is reprinted from the ELECTRICAL WORLD of June 20, 1931, page 1194.

Water power predominates in three of the nine geographical regions, the East South Central, Mountain and Pacific.

Table I—Classification of Plants and Output, 1931

Type of Plants	Companies	Plants	Capacity (Kw.)	Total Output (Kw.-Hr.)
Central stations	1,455	3,746	33,483,821	86,663,186,000
Electric railways	32	46	1,129,460	2,106,898,000
Electric railroads	5	6	290,560	711,301,000
Bureau of Reclamation	6	16	95,690	242,236,000
Public works	7	9	297,250	754,838,000
Manufacturing	63	77	293,291	1,250,931,000
	1,568	3,900	35,590,072	91,729,390,000

Table II—Classification of Plants and Output, 1930

Type of Plants	Companies	Plants	Capacity (Kw.)	Total Output (Kw.-Hr.)
Central stations	1,490	3,751	31,976,138	89,951,758,000
Electric railways	40	54	1,143,310	2,577,485,000
Steam railroads	6	7	274,560	699,438,000
Bureau of Reclamation	3	10	32,390	145,053,000
Public works	9	13	345,780	1,119,018,000
Manufacturing	61	69	491,766	1,443,345,000
	1,609	3,904	34,263,944	95,936,097,000

Table IV—Annual Production of Electricity for Public Use in the United States, 1919-1931

	Total, Millions of Kw.-Hr.	Water Power: Millions of Kw.-Hr.	Water Power: Per Cent of Total	Fuel Power: Millions of Kw.-Hr.	Fuel Power: Per Cent of Total
1919	38,921	14,606	37.5	24,315	62.5
1920	43,555	16,150	37.1	27,405	62.9
1921	40,975	14,970	36.5	26,005	63.5
1922	47,654	17,207	36.1	30,447	63.9
1923	55,665	19,343	34.8	36,322	65.2
1924	59,014	19,969	33.8	39,044	66.2
1925	65,870	22,356	33.9	43,514	66.1
1926	73,791	26,189	35.5	47,602	64.5
1927	80,205	29,875	37.2	50,330	62.8
1928	87,850	34,696	39.5	53,154	60.5
1929	97,352	34,629	35.6	62,723	64.4
1930	95,936	33,021	34.4	62,915	65.6
1931	91,729	30,603	33.4	61,126	66.6

Table V—Annual Consumption of Fuel in the Production of Electricity for Public Use in the United States, 1919-1931

Year	Coal, Thousands of Short Tons	Fuel Oil, Thousands of Barrels	Gas, Millions of Cubic Feet	Coal and Equivalent,* Thousands of Net Tons	Output from Coal and Equivalent,* Millions of Kw.-Hr.	Fuel Consumption per Kw.-Hr: Lb.	Fuel Consumption per Kw.-Hr: Per Cent of Rate in 1919
1919	35,100	11,050	21,406	38,880	24,175	3.2	100
1920	37,124	13,123	24,702	41,420	27,248	3.0	94
1921	31,585	12,045	23,722	35,240	25,863	2.7	84
1922	34,179	13,197	27,172	38,000	30,234	2.5	78
1923	38,966	14,684	31,433	43,522	36,088	2.4	75
1924	37,556	16,630	48,443	43,130	38,808	2.2	69
1925	40,222	10,246	46,521	44,780	43,264	2.1	66
1926	41,311	9,399	53,207	45,856	47,274	1.95	61
1927	41,888	6,782	62,919	45,910	49,995	1.84	57
1928	41,350	7,158	77,326	46,387	52,793	1.76	55
1929	44,937	10,124	112,707	52,574	62,284	1.69	53
1930	42,898	9,260	120,290	50,654	62,514	1.62	51
1931	38,734	8,123	139,328	47,134	60,768	1.55	48

*Output by use of wood not included.

Table III—Capacity of Generators in Power Plants Generating Electricity for Public Use, December, 1931

				Generator Capacity of Plants Operated by: One Type of Prime Mover: Water Power: No.	Water Power: Kw.	Steam Power: No.	Steam Power: Kw.	Internal Combustion Engs.: No.	Internal Combustion Engs.: Kw.	Combination of Two or More Types: No.	Combination of Two or More Types: Total Kw.	Combination of Two or More Types: Water Power	Combination of Two or More Types: Steam Power	Combination of Two or More Types: Int. Comb. Engines
Division and State	Companies	Plants	Total Capacity, Kw.											
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
United States	1,568	3,900	35,590,072	1,350	9,392,229	1,457	24,894,265	807	347,793	286	955,785	278,693	573,332	103,760
New England	148	334	2,938,472	214	786,594	83	2,014,520	6	4,216	31	133,142	21,683	109,160	2,299
Middle Atlantic	155	428	8,890,063	201	1,293,024	180	7,413,590	21	19,177	26	164,272	125,320	36,710	2,242
East North Central	308	689	8,151,065	264	650,430	349	7,264,893	35	18,604	41	217,138	20,122	187,758	9,258
West North Central	363	732	2,640,658	107	459,495	273	1,913,981	277	114,685	75	152,497	13,301	100,355	38,841
South Atlantic	170	462	4,354,791	155	1,859,716	180	2,304,585	98	42,053	29	148,437	59,694	82,349	6,394
East South Central	80	225	1,714,143	34	926,581	103	722,914	73	20,965	15	43,683	23,615	17,302	2,766
West South Central	134	422	1,682,753	16	74,835	141	1,454,461	239	100,832	26	52,625	1,080	32,087	19,458
Mountain	130	314	1,185,734	154	778,726	82	350,874	47	19,324	31	36,810	9,718	5,881	21,211
Pacific	80	294	4,032,393	205	2,562,828	66	1,454,447	11	7,937	12	7,181	4,160	1,730	1,291

Summarized Cost of 220-Kv. Line

The highest voltage transmission line in New England is that of the New England Power Association system, connecting the lower development at Fifteen-Mile Falls, Monroe, N. H., with the important terminal substation at Tewksbury, Mass. The line is 126.4 miles long; it is operated at 220 kv. and occupies a right-of-way 350 ft. wide, with room for three circuits, two having been installed. Much interest attaches to the design, which was described by C. A. Booker in the ELECTRICAL WORLD, September 6, 1930, page 443. The Power Association has recently filed the construction costs of this line with the New Hampshire Public Service Commission.

To facilitate the use of these costs a brief summary of the main features of the line is added herewith. The right-of-way contains 5,345 acres, of which 4,745 required clearing. Two single-circuit steel tower set-ups are provided 183 ft. apart, leaving space in the center for the third line when required. The standard distance between towers is about 600 ft. longitudinally. The towers are of six general types: (1) "S," suspension anchor every seven spans or less to attach ground wires firmly every 0.75 mile and permit longitudinal oscillation; (2) "T," full anchor tower every 3 miles or less; (3) "X," transposition tower evry 10 miles (there are four complete transpositions between Fifteen-Mile Falls and Tewksbury); (4) "U," large angle tower; (5) "W," special railroad crossing tower; (6) "R," standard.

Major Cost Items Fifteen-Mile Falls Line

Length, 126.4 Miles; Transmission, 220 Kv.; Fifteen-Mile Falls, Tewksbury, Two circuits installed, with space for third. No substation or switching station costs included in above.

Item	Cost (Cents Omitted)
Construction superintendence	$27,878
Accounting and field office expense	32,018
Casualty expense	581
Surveys and field engineering	90,385
Insurance and taxes during construction	80,994
Inspection and testing two towers at factory	18,336
Clearing and burning brush (labor proportion, $433,921)	458,807
Towers — Excavation and backfilling (labor, $204,462)	269,892
Setting footings and anchors (labor, $100,885)	118,031
Sorting and distributing steel (labor, $78,238)	106,364
Erection (labor, $114,349)	122,786
Distribution of line material (labor, $25,330)	37,993
Stringing power and ground wires (labor, $141,541)	173,924
Guying (labor, $1,000)	1,485
Towers, delivered at railroad siding	775,253
Power wire, 772.8 miles	912,451
Overhead ground wire, 513.2 miles	107,599
Power insulators and hardware	454,108
Tie wire, protecting and splicing sleeves	41,845
Telephone line (arrangement with New England Tel. & Tel Co.)	15,664
Telephone booths, 24	1,220
Extra ground wire 0.5 mile out from Fifteen-Mile Falls, Tewksbury, and each side of Central N. H. switching station, ⅜ in. and ⅞ in. wire used	15,670
Camp operating costs, etc	14,137
Tools and equipment	34,896
Total construction cost	$3,912,330
Land and right of way (including aerial survey, $5,990)	683,475
Interest during construction	229,028
Contractor's expense, including engineering, administration, etc.	390,643
Grand total cost	$5,215,478
Grand total cost per mile	41,250

Standard towers, "R," have a longitudinal width of 3 ft.; width across line, 19 ft.; height to crossarm, 55 ft.; length of crossarms, 47 ft.; spacing of conductors, 23.5 ft.; spacing of ground wires, 25 ft.

The power wires consist of aluminum steel-reinforced cable of 795,000 circ.-mil section, the conductor diameter being 1.093 in. and the weight per ft. 1.024 lb. Two ground wires are used per circuit, each being seven-strand plow-steel cable, 0.5 in. in diameter. The center conductor is suspension-hung from a bridle composed of two separate fifteen-disk strings mounted V-fashion. Tower footings are of earth grillage and of rock shoes. The number of towers of each type was "R," 1,882; "S," 216; "T," 68; "U," 34; "W," 30, and "X," 24.

The accompanying cost data include engineering, planning, designing, executive service in administration and financing, legal, purchasing, treasury staff services, field accounting, insurance, construction and material.

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Room Count at Malden

An analysis of the number of rooms listed in the residential service of the Malden (Mass.) Electric Company in relation to the two-rate schedules applying to this class of business has recently been prepared to show the number of customers concerned in each group of rates and room numbers. This is of comparative interest to utilities employing promotional rates. The rates follow:

Schedule A

Service charge, 50 cents per month
First 30 kw.-hr. at 7.5 cents each, net
Excess above 30 kw.-hr., 6 cents each, net.

Schedule A-1

Optional room rate	Cents per Kw.-Hr.
Minimum charge, 50 cents per month	
First 4 kw.-hr. per room per month	8.5
Next 4 kw.-hr. per room per month,	5.5
Excess over 8 kw.-hr. per room per month	3.5

More than half of the company's residential customers reside in homes of five or six rooms. In 1931 the average monthly bill per customer covered 40.5 kw.-hr. on the combined rates and the average price per kilowatt-hour was 7.03 cents. For the average family the annual electric service bill was $28.

Distribution of Rooms Among 46,724 Residence Customers

Rooms	Number of Customers on Rate Schedule A	Number of Customers on Rate Schedule A-1	Total Residence Customers
3	0	2,556	2,556
4	0	5,056	5,056
5	0	12,342	12,342
6	1	13,360	13,361
7	15	6,247	6,262
8	3,190	36	3,226
9	1,410	5	1 415
10	687	1	688
11	342	1	343
12	169	0	169
13	57	0	57
14	34	0	34
15	18	0	18
16	9	0	9
17	2	0	2
Over 17	3	4	7
Unknown	1,179	0	1,179
Totals	7,116	39,608	46,724
Average rooms	8.88	5.4	5.85

More Effective Capacity for Less Cost

By B. M. JONES
Planning Engineer
Duquesne Light Company, Pittsburgh, Pa.

Eleven substations of the type considered are being used by the Duquesne Light Company and have proved very satisfactory in that no trouble of any consequence has been obtained with them. They have been found more economical than older type substations with lines terminating on the bus and the usual arrangement of breakers, buses and transformers.

SEVERAL years ago the planning division and the engineering department of the Duquesne Light Company developed a new type of simple, economic distribution substation for full automatic operation. The design has been modified with various improvements from time to time, but still adhering to the essential features of the original design, and these type "ECS" substations proved most satisfactory from both the operating and economic standpoints.

One of the main features (Fig. 1) is that only one high-tension oil circuit breaker is used, with one transformer bank connected to each incoming line and the high-tension breaker sectionalizing two lines. The relaying for operating the high-tension breaker is so arranged that it will trip the proper low-tension transformer bank breaker at the same time the high-tension breaker is tripped, and thus prevent a step-up transformation from the good line onto the faulty line. The effective transformer capacity of these two-bank stations is 150 per cent of one bank, this condition arising when one transmission line or transformer bank is out of service, thus necessitating carrying the load on the remaining bank.

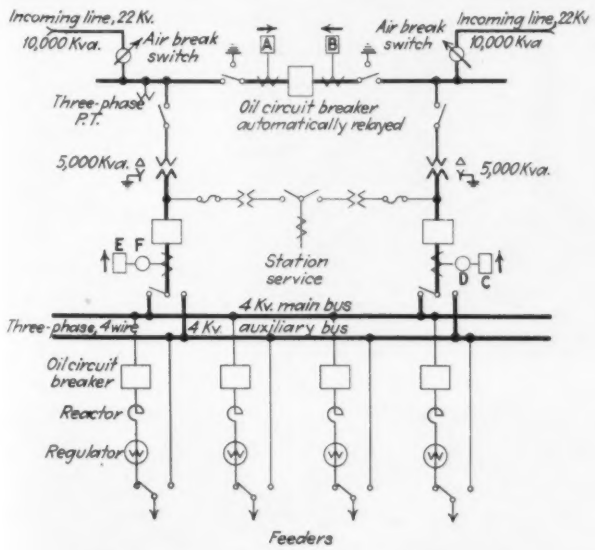


Fig. 1—Essential elements of automatic distribution substation

Of course, the 24-hour load characteristics must be such that one bank can carry the 150 per cent load over the peak load of the district, which is usually an evening peak of some three to five hours for the residential lighting. A typical residential 24-hour load for which this type of station is very suitable is shown in Fig. 2. The load characteristics shown in Fig. 3 would not be suitable for this two-bank type of station unless the transformers are single-phase units and a spare transformer is installed in the station. In this case the remaining bank could carry the load for the two or three hours' time required for the maintenance crew to remove the damaged single-phase unit from the other bank and replace the spare, and thus re-establish both banks in service. Dependent upon the location of the station from the repair crews' headquarters, this condition could prevail. However, the use of three-phase transformers may react unfavorably toward the use of the two-bank type of station for this class of load, as in this case it would not be justified in retaining a spare three-phase transformer (the third one) at the station, and this would mean some seven or eight hours for the repair crew to bring the transformer from the storeroom and would very likely overload the remaining bank beyond its safe limits. Power transformer failures are quite rare on our system, averaging a very long life per unit without a failure.

The short-circuit duty on the circuit breakers on the low-tension side is, of course, that which will be delivered

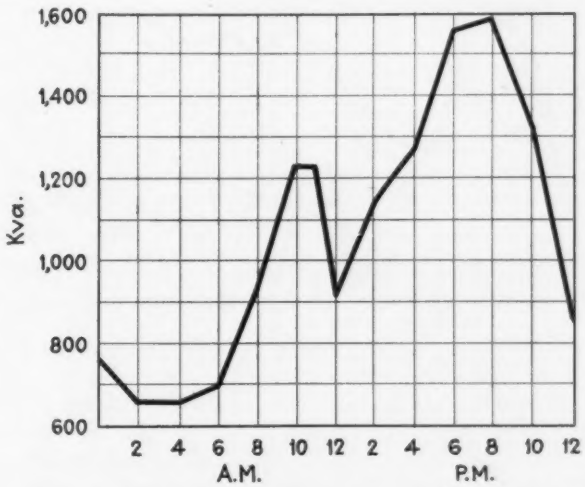


Fig. 2—Load characteristics for which type ECS substation is very suitable

with both banks in service, and using 8 per cent impedance transformers up to and including 10,000 kva. the circuit breakers required are not excessive in cost.

Station service is taken from each power transformer bank by means of a small step-down transformer connected through fuses to each main transformer bank ahead of the transformer breaker. The low-tension circuit of this station service transformer is carried to an automatic throw-over switch, which normally supplies station service energy from one bank and which changes to the other in case the first is out of service.

Relaying is relatively simple. It consists of directional phase and ground relays on the high-tension breaker to fit in with the remainder of the relaying of the transmission system and with overload protection on the low-tension side of the transformer bank, as well as directional relays which operate when power flows toward the transformer bank on the low-tension side and trips the transformer bank breaker. This latter set of directional relays is necessary to insure tripping the bank breaker on the low-tension side in case of high-tension trouble or power bank trouble and is a "back-up" to the high-tension breaker directional relays, which also trip this transformer bank breaker. Each feeder is protected with the usual overload relays.

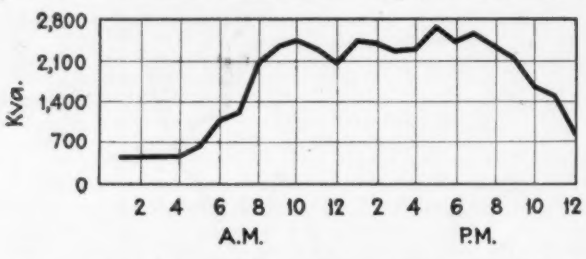


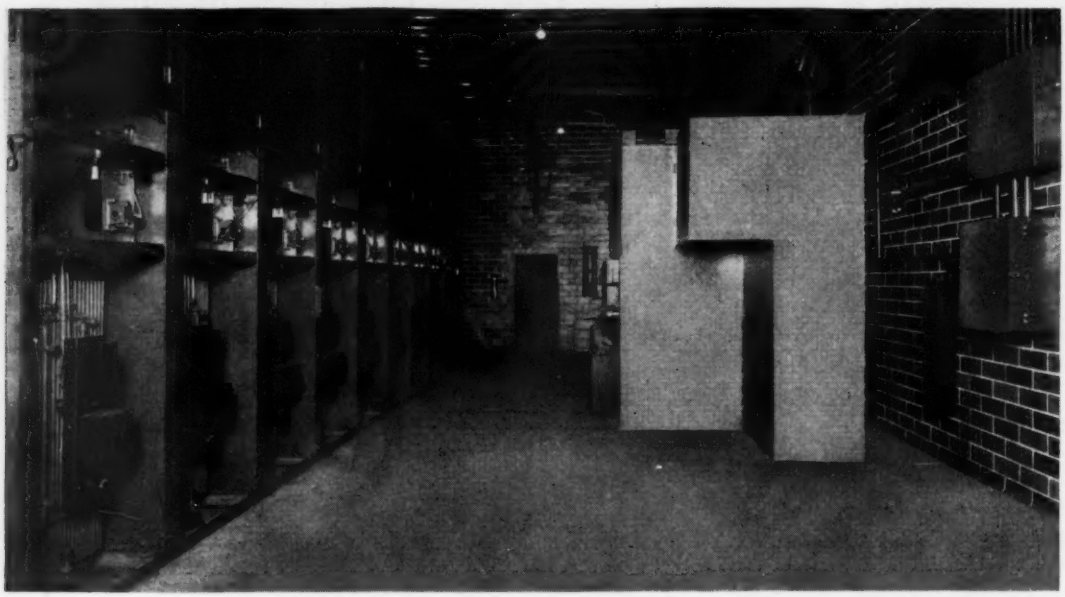
Fig. 3—Under certain conditions this type of load can be handled by type ECS substation

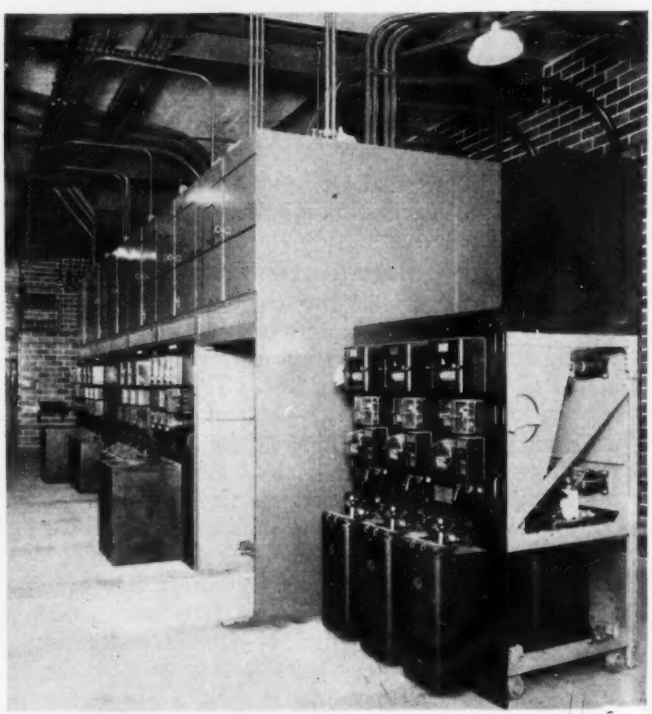
An auxiliary or reserve 4-kv. bus is provided at these stations, onto which the transformer bank and feeders can be connected by means of disconnecting switches.

Full automatic features are included and no attendant is on duty. The automatic control crew makes an inspection once a week and other equipment inspections are made periodically by the same organization.

One convenient economical feature of this type of station is the fact that the circuits from the bank to the bus, to the breakers and to the reactors and regulators are not carried underground, but are brought in the side of the building through iron pipes and are carried in iron pipes on the ceiling overhead and drop down into the various compartments as required, which is very convenient and inexpensive. This particular feature was developed for the early stations of this type and proved so satisfactory and economical that it has been used on all later stations practically without any modification.

This type of station, with certain modifications of minor consequence, is being used for rotary converters supplying street car service similar to the transformer banks supplying distribution energy. "All indoor" or "all outdoor" or "semi-indoor" arrangements can be worked into the design.





Figs. 4 and 5 — Two substations conforming to principle shown in Fig. 1

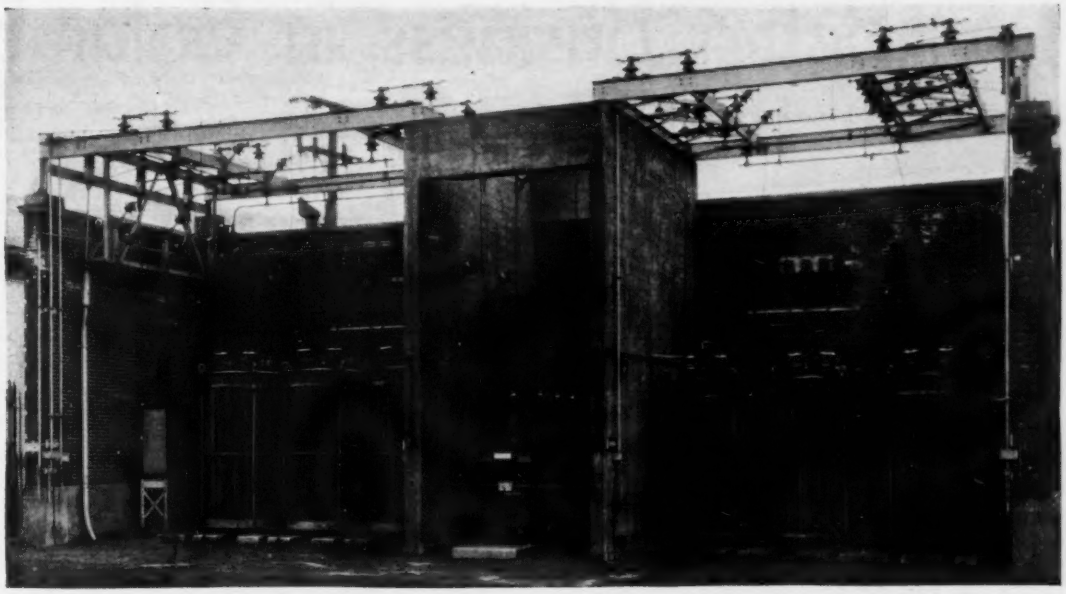


Fig. 6 — Typical outdoor transformer installation with protecting wall between breakers and bank

For serving loads with a certain 24-hour characteristic, which includes a distinct evening peak (Fig. 2), they are most suitable, and this includes all features such as service reliability, first cost and operating costs, maintenance on high-tension switches, lack of attendants, two banks in service with each acting as a spare to the other, adaptability to relatively small pieces of inexpensive property that can usually be obtained in the proper location and many other desirable features.

For stations of comparable effective installed transformer capacity and number of feeders—that is, for a type "ECS" station with 3,000 kva. effective transformer capacity (two 2,000 kva. units installed and one out of service and the other loaded to 150 per cent of its capacity), two 4-kv. circuits, one high-tension breaker and two high-tension lines compared to the usual type of substation with two high-tension lines on a bus through two high-tension breakers and with two 2,000 kva. banks and two 4-kv. feeders—the cost for the "ECS" station is from 15 to 20 per cent lower, dependent upon the building, architectural features and yard and landscaping costs, together with the grading costs of the property. This figure of 15 to 20 per cent does not include the cost of the property, which, of course, cannot be compared for any stations, as it varies too widely over the country and on the same system.

At the present time there are eleven of these stations in service on our system, ranging in capacity from two 2,000-kva. banks with two 4-kv. regulated feeders to two 6,000-kva. banks with three 4-kv. feeders and also including one rotary substation with two 1,000-kw. units. During 1930 one new station of the "ECS" type was cut into service and one old station was revamped into a type "ECS" station; one with two 1,000-kw. rotary converter was built in 1931.

The largest "ECS" station in service is the Homewood substation, which at the present time contains two high-tension lines, one high-tension breaker, two 6,000-kva. transformer banks, together with three 4-kv. feeders and street-lighting equipment for three circuits. This station is laid out to take three 10,000-kva. transformers and three 10,000-kva. transmission lines and twelve 4-kv. circuits and street-lighting equipment. The present building is suitable for eight 4-kv. circuits and two 10,000-kva. banks. One feature of this station is the remote indication and control for the street-lighting equipment that is handled from the system operator's office in the main office building in downtown Pittsburgh, a distance of about 5 miles.

The economies of this type of substation make it quite desirable for picking up loads that are a long way from another substation and are more or less isolated, and several of them are installed with two 2,000-kva. transformer banks and two 4-kv. feeders and they can be located at most convenient points for handling their loads. In all cases these substations are provided with facilities for sufficient growth in the way of property, duct lines and pipes, etc., but the banks are usually installed for three to five years of growth, contingent upon the next larger size of transformer available.

The transformers are reliable equipment, requiring little attention and small operating and maintenance expense. It was therefore attempted to design the station around the transformer, reducing the oil circuit breaker installations to an absolute minimum, which resulted in the design of the economical station just described.

▼

Coal Bunker Painting Simplified

The inside walls of coal bunkers must be cleaned and painted at regular intervals, in the opinion of some companies. This work was formerly done in the 50-ft. bunkers of the Trenton Channel power plant, Detroit Edison Company, by emptying the bunkers and working from scaffolds. The new method hit upon by the foreman of the housekeeping crew of the station is first to clean and paint the bunker floor and as much of the walls as the workman can reach from the floor. After the paint dries the bunker is partly filled with coal and from the top of the pile the men clean and paint another portion of the walls. When this dries the bunker is filled with a few hundred more tons of coal, and so on until the top is reached. By the time the work is done the bunker is again filled with coal.

Better Business in Columbus

Radio broadcast by Better Business Bureau tells of fixture rackets and inferior lamps.
An example of community co-operation with utilities.

THE Better Business Bureau of Columbus, Ohio, believes in doing things. The following radio broadcast by Harry Van Horn, general manager, this spring, dealt constructively with local electrical affairs and was well received. The address follows:

"The files of the Columbus Better Business Bureau have ample evidence that one of the very substantial rackets in this country is selling to the uninformed user of electric current questionable and inefficient electric lamps and electric lamp fixtures.

"In January of this year the Columbus Bureau was active in breaking up the sales campaign in our city of an electric lamp company, with headquarters in New York. It had a crew of eighteen salesmen operating from a downtown hotel headquarters. The salesman called on a prospective customer and asked permission to attach to his light socket an extension with a three-way lamp socket on the end. He then would put a lamp being used by the prospective customer in one socket and attach next to it one of his own lamps, of presumably the same wattage consumption. The prospective customer could very easily see that the salesman's lamp gave more light. The salesman told him that his lamps of equal wattage consumption would not only give more light but would last longer and use less current. The customer then found, after he had agreed to buy, that the price of the salesman's lamp was three times that of the standard lamp.

"Several sets of these lamps were collected by the Better Business Bureau and some of the local business men and tests were made. It was found that all representations were untrue; that the lamps consumed more watts than the marking indicated, which meant that the actual electricity consumed would cost the user more money, and that the lamps did not last as long.

"The Better Business Bureau exposed this sales campaign through a radio talk and through bulletins direct to business men of the city, which resulted in the sales crew breaking up. Some of them moved to a town in West Virginia, where the Better Business Bureau there caused the police to investigate, and the campaign ended in that city. This sales crew had been traveling for many months through the entire middle western section of the country and the sales ran into thousands of dollars.

"Our files show that in December of 1930 two young men who represented the high-sounding company name of the General Illuminating Division of the General Illuminating Company of Chicago spent the night in the Columbus city jail as a result of their activities in selling electric light fixtures to Columbus merchants. These salesmen represented themselves falsely to be salesmen for the General Electric Company and falsely represented the qualities of fixtures which they sold for $18 each, whereas a reasonable retail cash price for such a fixture was only a fraction of that amount.

"In September of 1930 Columbus was visited by the agent of the Western Illuminating Company of Chicago, who was selling a light fixture for which he charged from $9 to $26. When this salesman was confronted by a local expert in the light fixture business he fled the city, leaving his samples behind at the hotel at which he was registered.

"Later on, the Federal Trade Commission in Washington issued complaints against various concerns operating in this manner, selling fixtures at $15.50 each, whereas the usual retail cash price for the same fixture was about $4.

Japanese lamps described

"Those of you who are listening in should be informed about the sale of electric lamps now imported from Japan at the rate of around three million lamps a month. Some of these Japanese lamps are on sale at certain retail stores in Columbus. In some sections they are peddled from door to door by salesmen. Scientific tests have been made of these Japanese lamps which sell at a low price, and in one test it was found that 44 per cent of those examined would not have been accepted for shipment under the American lamp manufacturers' prescribed standards. Defects in American "Mazda" lamps tested brought about an estimated reduction in value of seven-tenths of 1 per cent, whereas the same test on Japanese lamps resulted in an estimated reduction in value of all Japanese lamps of 17 per cent, or more than seventeen times as much as that of American "Mazda" lamps. Tests made of Japanese lamps and the typical American lamps, with respect to the light output and the amount of current consumed, show that more than 70 per cent of the Japanese lamps purchased through dealers do not meet the American standards of lamp rating in this particular. Tests made on the cost of the electricity for American lamps and Japanese lamps show that the Japanese lamps cost about one-third more for the light received.

"Because of our interest in this general merchandising problem, the Columbus Better Business Bureau has purchased electric lamps offered for sale by the various principal merchants, department stores, 10-cent stores, electric shops, etc., in the city. Preliminary tests have already been made, and it was discovered that some of our leading merchants were unwittingly selling lamps which were inaccurately marked as to electric current consumption, and therefore as to the cost of the light which they produced. We are confident that the large majority of these merchants were doing this unknowingly and that they have no desire to sell electric lamps

in a manner which will deceive or mislead their customers or take advantage of the lack of knowledge on their part. About three dozen of these lamps have been forwarded to the electrical department of the Bureau of Standards at Washington, D. C. That department of the federal government has agreed to make tests of the lamps, which will give us undisputed facts about their consumption of electric current, their efficiency in giving light, etc. This information will be released to the public some time in the near future.

"A recent advertisement in the *Saturday Evening Post* points out that the public should not buy lamps merely on a price basis, but should consider the ultimate cost of furnishing light in their homes through the operating efficiency of each lamp, which, as very accurately stated, is more important than the original price of the lamp itself. This advertisement is very timely. Members of the public should give this item some thought because the national expenditure for electric current and for electric lamps runs into a tremendous figure.

"To illustrate the point of this advertisement with an experience we had in our investigation, let me tell you the following: A lamp was purchased in a Columbus department store marked to consume 50 watts. Upon being tested it was found that it actually consumed 71. This means that if it would burn twenty hours it would consume 1,420 watts. Payment at the rate of 6 cents per 1,000 watts would be about 8½ cents for twenty hours, whereas if the lamp had consumed 50 watts, as it was marked, instead of the 71, which was the actual consumption, it would have used only 1,000 watts in twenty hours, which would cost about 6 cents. Two and one-half cents difference for twenty hours on one light does not in itself seem very much, but when you multiply it by, say, twenty lamps in the average home and then realize that in central Ohio alone there are probably around a quarter of a million users of electric lamps you get some idea of the importance of the statements made in the advertisement.

Offers aid on quality buying by consumers

"Very naturally, those of you who are listening in say to yourselves: 'How can we tell which lamps are efficient and which lamps are cheap in price, but costly through increased consumption of electric current?' Our answer to this question is that you have but to inquire of the Columbus Better Business Bureau. If we have not already had tests made of the particular lamps you have in mind, we will be glad to arrange to have fair and impartial tests made, so that when you buy in the future you can buy intelligently. This service from the Better Business Bureau will cost you nothing and it may save you, over the period of the years to come, a very substantial sum of money.

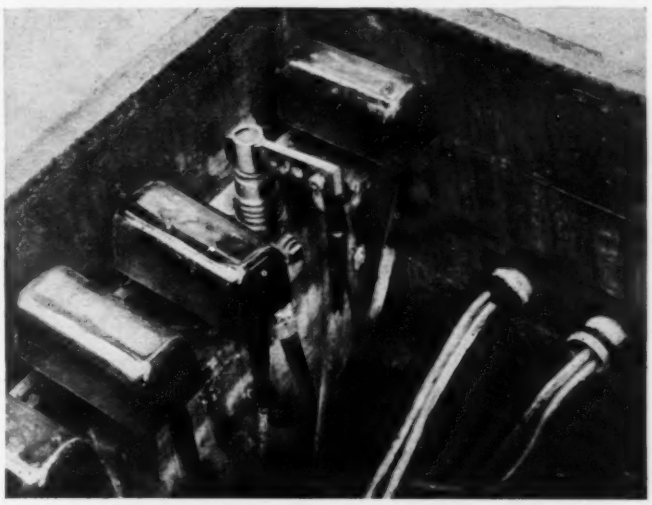
"Remember that it is the job of the Columbus Better Business Bureau to do all that it can to keep Columbus business clean and to make of it a safe place in which to trade. The bureau is supported financially by the leaders in the field of legitimate business who make it possible for us to serve you without cost. We welcome complaints about the purchase of merchandise or service where members of the public feel that misrepresentations were made which caused them to spend their money."

Making Flexible Underground Service Connections

By R. J. RAINNIE

To facilitate connecting building services in the Woonsocket division of the Blackstone Valley Gas & Electric Company in Rhode Island with street underground secondaries a convenient type of sidewalk pull box has been developed. "G & W" cable end seals equipped with mounting lugs are used and Hartford faience porcelain covers provided to cap the live terminals and do away with taping. The pull box is of concrete, 36x42 in. at the bottom, 36 in. deep and 30x30 in. at the top with a 5-in. wall. The side on which the duct lines enter is made vertical, plates being inserted at the concrete pouring. These are used later to support a 1.5x1.5x0.25-in. angle 31.5 in. long, drilled for mounting five cable-end seals on 6-in. centers.

Lateral ducts were run when the original manhole and duct lines were installed in the street. In installing secondary cables, these are made up to the end seals,



Pull box opened, showing porcelain cover removed from one end seal and terminal lug

Service cable connection at top and incoming lateral connections at bottom. The three terminals at the right are for 230-volt, three-phase service while the two at the left are the live legs of 115-230-volt secondaries.

which are bolted in a vertical position on the angle-iron. The porcelain cover protects the entire top of the end seal, lug and service cable termination. The neutral wire, which is carried in the main duct system with the lighting secondaries, is brought up to a 0.25x2-in. copper strap fastened securely to the opposite side of the box from the end seals and set out from the wall about 1 in. Service grounds are attached to this strap with lugs and bolts, several holes of various sizes being provided for flexibility. The live legs of the service cables also terminate in lugs which are bolted to the end-seal lugs. To disconnect a service or install additional services it is only necessary to remove the cover from the required terminal. The G & W Electric Specialty Company, Chicago, has lately developed a unit device of this type.

Availability of Converters Slightly Higher Than Rectifiers

Based on 1931 experience with automatic mercury-arc rectifier and rotary-converter substations, O. M. Ward, superintendent of operation Milwaukee Electric Railway & Light Company, reaches the following conclusions*: (1) There is practically no difference in operation and maintenance costs of the two types of converting equipment, taking into consideration the higher efficiency of rectifiers. (2) Service availability of converters is slightly higher than service availability of rectifiers when the converting equipment is unattended and equipped with automatic control. (3) Rectifiers have not been responsible for complaints from telephone companies or radio users. (4) Control system failures in whole or in part are vastly more serious in automatic than in manually controlled stations. (5) More attention should be given to auxiliary relays, operating coils, protective equipment, etc., used in automatic control systems, to insure against faults in them.

The relative operating costs and service failures of the two types of substations are shown in the accompanying graph and tables. The rise in operating expenses of rectifier stations to a value of approximately $112 per month in April, 1930, and the subsequent drop is explained by ignition and excitation troubles, which were corrected early in 1930. The increase during 1929 in synchronous converter operating expenses was the result of d.c. riser troubles in one machine and shunt field failures in the other machine.

It will be noted from the tables that the average time per year a rectifier is not available for service is approximately eighteen times greater than the non-available time of rotary-converter stations during this three-year period. However, a great improvement in service availability of rectifiers was effected when the ignition and excitation troubles were corrected in 1930, and this improvement is clearly indicated in the 1931 record when the average number of failures dropped from a previous two-year average of 6.6 failures per unit per year to an average of three failures per unit in 1931. The hours outage improvement during 1931 as compared with the two previous years is much more impressive. During 1929 and 1930 the annual service outage per station amounted to 213 hours and 57 minutes, while in 1931 this figure dropped to three hours and 28 minutes. The improvement, pronounced as it is, still leaves rectifier troubles and outages above the 1931 record of synchronous-converter stations.

However, in arriving at conclusions it is manifestly unfair to neglect the fact that these rectifier stations were the first, or if not the first one of the earliest, installa-

Table I—Rotary Converter Service Failures

Station	Year[1]	Number of Failures	Available for Service Hours	Available for Service Minutes	Outage per Failure Hours	Outage per Failure Minutes
Chamberlain[2]	1929	2	7	50	3	55
Wind Lake[3]	1929	2	5	30	2	45
Chamberlain	1930	5	14	25	2	53
Wind Lake	1930	7	19	45	2	50
Chamberlain	1931	1	2	0	2	0
Wind Lake	1931	1	1	0	1	0
Both	1929	4	13	20	3	20
Both	1930	12	34	10	2	51
Both	1931	2	3	0	1	30
Both	1929 to 1931, inc.	18	50	30	2	48

Average number of failures per station per year 3
Average time station is not available for per service year. 8 hours 25 minutes
Average length of outage per failure ..... 2 hours 48 minutes

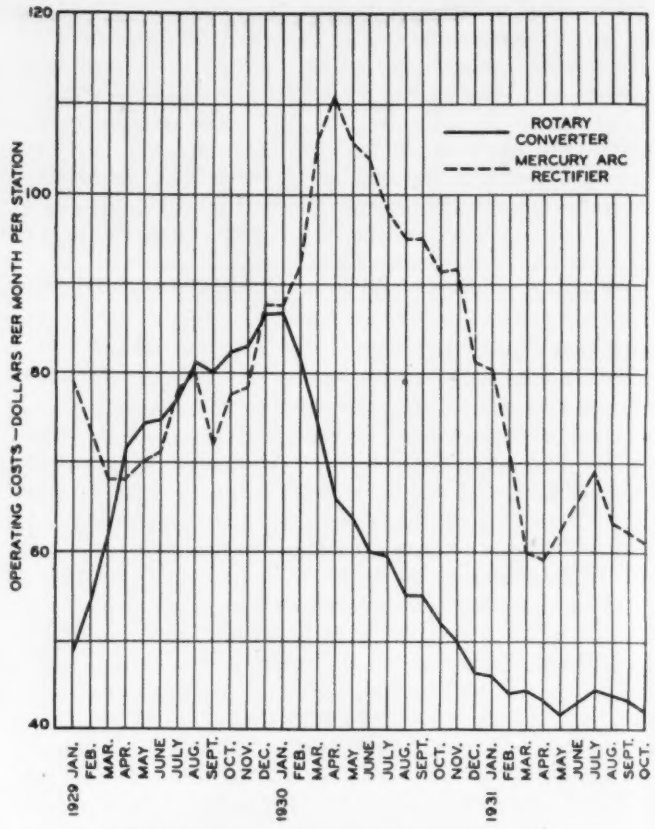
[1] Year 1929 includes November and December of 1928, in addition to all of 1929. Year 1931 does not include November and December of 1931.
[2] Chamberlain rotary has 200 per cent momentary overload rating.
[3] Wind Lake rotary has 100 per cent momentary overload rating.

Table II—Mercury Arc Rectifier Service Failures

Station	Year*	Number of Failures	Time Not Available for Service Hours	Time Not Available for Service Minutes	Average Outage per Failure Hours	Average Outage per Failure Minutes
Nemahbin	1929	17	758	43	44	38
Oconomowoc	1929	8	121	20	15	10
Pipersville	1929	3	82	50	27	37
Nemahbin	1930	2	1	14	..	37
Oconomowoc	1930	4	59	20	14	50
Pipersville	1930	6	260	15	43	22
Nemahbin	1931	1	1	18	1	18
Oconomowoc	1931	5	4	6	..	49
Pipersville	1931	3	25	44	8	35
All	1929	28	962	53	34	23
All	1930	12	320	49	26	44
All	1931	9	31	8	3	28
All	1929 to 1931, inc.	49	1,314	50	26	50

Average number of failures per station per year 5.4
Average time station is not available for service per year 146 hours 5 minutes
Average length of outage per failure ..... 26 hours 50 minutes

*Year 1929 includes November and December 1928 in addition to all of 1929. Year 1931 does not include November and December 1931.


120
100
80
60
40
OPERATING COSTS—DOLLARS PER MONTH PER STATION
ROTARY CONVERTER
MERCURY ARC RECTIFIER
1929 JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
1930 JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
1931 JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT.

Relative operating costs of rectifier and converter stations

The cost indicated is the average monthly expense for the year ended on month shown, except for January-May, 1929, when average of seven to eleven months' expenses are given.

*Presented at Great Lakes meeting of A.I.E.E. in Milwaukee.

tions with full automatic control in unattended substations. Full-automatic rotary-control stations had been in service many years. Therefore, the 1931 record may be assumed to be more indicative of normal performance.

The data are based on three single-unit rectifier stations and two rotary-converter stations placed in service in 1927 and 1928 respectively. Both had 500-kw., 600-volt units. The rectifiers had a guaranteed overload rating of 25 per cent for one-half hour, 50 per cent for three minutes and 100 per cent for one-half minute. Some of the synchronous converters have momentary overload ratings of 100 per cent and others 200 per cent. Each has 50 per cent overload rating for two hours.

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Dielectric Research Proceeding on Simple Substances

Evidence that dielectric research is being prosecuted further back into the fundamental phenomena of the behavior of simple molecular structures was presented at a recent meeting in Washington of the subcommittee on physics of the National Research Council's committee on electrical insulation. In research sponsored by Dr. V. Karapetoff of Cornell at several colleges, government and industry laboratories intensive studies of selenium, cellulose, rubber, hydrocarbons, rochelle salt, iceland spar, mica and paraffins have contributed to a more basic establishment of the laws of composite dielectrics.

At the Bell Telephone laboratories studies on a built-up selenium crystal showed that illumination changed the conductivity of the crystal. As for the photo-electric response the magnitude was sometimes found to be proportional to the light intensity and sometimes to its square root. Mercuric iodide reveals, under long wavelength illumination, a current-voltage characteristic in which the current saturation is proportional to the light intensity; for shorter wave lengths saturation is attainable only for weak illumination intensities. The absorption current for cellulose was found not to be due to its moisture content, as commonly supposed, but to the cellulose itself; the moisture, however, influences the leakage conductivity. The theory of the mechanics of impregnation has also been advanced. Impregnation is found to be more complete and dielectric strength higher when moisture combined chemically with the cellulose is removed in the presence of the impregnating compound rather than when removed previous to impregnation.

Capillary absorption studied

Work at Johns Hopkins University under the direction of Prof. J. B. Whitehead, chairman of the committee on electrical insulation, has also reinforced the impregnation theory through a critical study of the interaction of capillarity and surface tension of impregnation oils in the presence of fibrous insulations, especially high-voltage cable paper. Capillary absorption was found accurately proportional to the square root of the time. The constant of proportionality between rise of the liquid in vertically suspended paper strips and the time includes the square root of the quotient of surface tension divided by viscosity. In the accelerated life tests on the endurance of impregnated paper under electric stress an interesting correlation has been disclosed between the life of the paper and the penetrativity of the impregnating oil.

Dr. H. L. Curtis of the Bureau of Standards reported that tests on rubber and rubber compounds showed that all compounds containing sulphur have a temperature at which the dielectric constant is a maximum. This temperature varies with the frequency and the sulphur content. Pure normal hydrocarbons reflect a time interval during which the conduction current remains constant as one that decreases with increasing voltage.

Oxygen-containing compounds in the presence of the hydrocarbons of cable insulation are being studied at Cornell University under the sponsorship of the Detroit Edison Company. Some water, aldehydes and acids result from the interaction of the two groups of substances and thus make for insulation deterioration. The larger the oxygen content the greater the increase in conductivity of the dielectric.

Rochelle salt is the object of dielectric and electro-optical studies at the Massachusetts Institute of Technology. The dielectric properties have a close analogy to ferromagetic behavior. Hysteresis loops, remanence and saturation have been measured. An electric field in the a-direction changes the double refractions of the crystal in a composite linear and quadratic manner. The linear component is attributed to a photo-elastic effect due to piezo-electric deformation. The quadratic effect is due to orientation of dipoles. Below dielectric saturation the effect is a quadratic hysteresis loop which presents a new and very accurate way to measure remanence and coercive force.

The next meeting of the committee on electrical insulation will be held in Baltimore, October 10 and 11, with one session likely to be held under joint auspices of the A.I.E.E., which has a district meeting scheduled at the same time and place.

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Painting Economizer Tubes

By A. N. SIMMONS
Detroit Edison Company

Every once in a while economizer tubes have to be painted inside to prevent corrosion. The usual method is to squirt a sufficient quantity of paint into the tube and then push through a circular brush to spread it. The job takes about two weeks for one economizer; a brush costs $6 and is worn out after painting 40 tubes. This looked like too long and too expensive a job to Jack Eataugh, foreman of the housekeeping crew at the Trenton Channel station of the Detroit Edison Company and he decided to do something about it. He took a piece of garden hose 8 in. long and made four equally spaced longitudinal cuts in it at the middle about 4 in. long. This he attached to a boiler tube cleaning head, which, revolving at high speed, caused the center sections to expand and fill the tube. A large quantity of paint is inserted in the tube and the hose shoved through, the excess paint being caught at the other end. The hose-made brush costs about 6 cents and will do 300 tubes and now an economizer can be painted in four days by three men.

Using Electrical Instruments to Best Advantage

By A. E. KNOWLTON
Associate Editor, ELECTRICAL WORLD

ELECTRICAL instruments in general have an unusually wide range of applicability within, of course, the specific range of indications for which they are designed. The relatively high degree of independence which their indications have of their internal characteristics gives them this broad usefulness. But among the uninitiated there is a considerable tendency to overlook the fact that those internal characteristics cannot always be ignored in making precision measurements. Some accuracy is therefore sacrificed by not selecting the instrument best suited to the circuit conditions encountered.

To show how these characteristics influence the performance a table has been prepared from data supplied by manufacturers. It has no pretension of inclusiveness or completeness. For instance, the General Electric series includes a DP-2 ammeter of 0.00015 range having 1,100 ohms and 0.165 volts full scale and also a DP-2 voltmeter of 0.0075 volts range with a resistance of 7.4 ohms. The table merely embraces a selected variety of ranges and types from which general conclusions can be drawn as to the extent to which the best design for general purposes results in mechanical and electrical properties that should be considered when using the devices

Mechanical and Electrical Constants Typical

No.	Instrument	Maker	Class	Model	Range		Moving Element						
									Torque			Damping	
					E	*I*	Weight Grams	Moment of Inertia Gm.-Cm.	Gm.-Cm. Full Scale	Gm.-Cm. per Radian	Factor A.I.E.E.	Gm.-Cm. per Rad. per Sec.	Fr... Cm... of Cri... in...
Permanent Magnet Moving Coil (D.C.)													
1	Ammeter.....	General Electric	P	DP-2	.....	0.15	2.0	2.0	0.24	0.15	.....	.....	...
2	Ammeter.....	General Electric	P	DP-2	.....	5	2.0	2.0	0.24	0.15	.....	.....	...
3	Ammeter.....	General Electric	P	DP-2	.....	500	2.0	2.0	0.24	0.15	.....	.....	...
4	Ammeter.....	Westinghouse..	P	PX-4	.....	1/5	1.5	1.08	0.173	0.099	20	0.0145	7...
5	Ammeter.....	Weston.....	P	1	.....	0.0003	2.16	2.0	0.206	0.137	.....	0.023	6...
6	Ammeter.....	Weston.....	P	1	.....	5	1.69	1.8	0.163	0.109	.....	0.022	7...
7	Ammeter.....	Weston.....	P	1	.....	500	1.69	1.8	0.163	0.109	.....	0.022	7...
8	Voltmeter.....	General Electric	P	DP-2	0.02	.....	1.4	2.0	0.09	0.057	.....	.....	...
9	Voltmeter.....	General Electric	P	DP-2	150	.....	2.0	2.0	0.50	0.32	.....	.....	...000
10	Voltmeter.....	General Electric	LS	DL-2	0.05	.....	2.0	.....	0.26	0.17	.....	.....	...
11	Voltmeter.....	General Electric	LS	DL-2	150	.....	2.0	.....	0.50	0.32	.....	.....	...000
12	Voltmeter.....	Westinghouse..	P	PX-4	15/150	.....	1.5	1.08	0.173	0.099	20	0.0145	7...
13	Voltmeter.....	Weston.....	P	1	0.01	.....	1.69	1.8	0.163	0.109	.....	0.022	7...
14	Voltmeter.....	Weston.....	P	1	3	.....	1.73	1.9	0.413	0.276	.....	0.034	7...
15	Voltmeter.....	Weston.....	P	1	150	.....	1.73	1.9	0.413	0.276	.....	0.034	7...
Electrodynamic (A.C., D.C.)													
16	Ammeter.....	Weston.....	LS	326	.....	5/10	3.4	24	0.29	0.193	.....	0.051	5...
17	Ammeter.....	General Electric	LS	PL-2	.....	0.25/0.5	8.2	55	0.26	0.17	.....	.....	...
18	Voltmeter.....	Weston.....	LS	326	300/150/75	.....	3.45	24	0.29	0.193	.....	0.051	5...
19	Voltmeter.....	General Electric	P	P-3	150	.....	4.8	15	0.24	0.15	.....	.....	...
20	Voltmeter.....	General Electric	LS	PL-2	150	.....	5.2	.....	0.35	0.22	.....	.....	...
21	Voltmeter.....	Westinghouse..	P	PY-5	150/300	.....	2.5	4.06	0.47	0.0791	16.5	0.0357	6...
22	S.P. Wattmeter	Weston.....	LS	326	150	5/10	3.85	24	0.29	0.193	.....	0.051	5...
23	S.P. Wattmeter	Weston.....	P	310	100/50	0.5/1.0	2.03	4	0.19	0.127	.....	0.026	5...
24	S.P. Wattmeter	Weston.....	P	310	150/75	1/2	2.03	4	0.19	0.127	.....	0.026	5...
25	S.P. Wattmeter	Weston.....	P	310F2*	150/75	1/2	1.86	3.6	0.14	0.093	.....	0.02	5...
26	S.P. Wattmeter	Westinghouse..	P	PY-5	150/300	5/10	2.5	4.06	0.12	0.0791	16.5	0.0357	6...
27	S.P. Wattmerer	General Electric	P	P-3	100	5	4.8	15	0.26	0.17	.....	.....	...
28	S.P. Wattmeter	General Electric	LS	PL	150	5	5.2	.....	0.40	0.25	.....	.....	...
Moving Iron (A.C.)													
29	Ammeter.....	Westinghouse	P	PY-5	.....	2.5/5	2.38	2.73	0.11	0.0715	12	0.0176	6...
30	Ammeter.....	Weston.....	P	155	.....	0.02	1.67	2.5	0.145	0.097	.....	0.012	3...
31	Ammeter.....	Weston.....	P	155	.....	5	1.67	2.5	0.125	0.083	.....	0.012	3...
32	Ammeter.....	Weston.....	P	155	.....	500	1.67	2.5	0.125	0.083	.....	0.012	3...
33	Ammeter.....	General Electric	P	P-3	.....	5	4.7	15	0.50	0.32	.....	.....	...
34	Voltmeter.....	Weston.....	P	155	30	.....	1.67	2.5	0.125	0.083	.....	0.012	3...
35	Voltmeter.....	Weston.....	P	155	150	.....	1.67	2.5	0.125	0.083	.....	0.012	3...

P = Portable. L.S. = Laboratory standard. SP = Single phase. *Low power factor wattmeter. Data given for lower or higher range of multiple range instrum...

for specific or special purposes. The table provides the basis for contrasting different types of instruments with regard to their losses, resistances and impedances, the burden which they create on instrument transformers and the extent to which their characteristics point to the desirability of applying corrections to their indications in precision measurements.

Some of the comparisons based on the actuating principle employed and on the limitations imposed by the different ranges provided are as follows:

1. Moving iron vs. electrodynamic vs. permanent-magnet moving coil types.
2. Voltmeters vs. ammeters.
3. Wattmeters vs. ammeters and voltmeters.
4. Low capacity vs. high capacity.
5. Portable vs. laboratory standard design.
6. Normal vs. low power factor wattmeters.

In the very first place it is evident that the manufacturers have standardized the characteristics so that they are either uniform for all capacities or else in general proportional (in the case of the electrical properties) to the rated capacity. The weights of the moving elements of moving-iron and permanent-magnet moving-coil instruments are of the same order of magnitude. Those of the electro-dynamic type are in general greater as a result of the greater length and weight of copper coil required to produce the requisite torque with the weaker magnetic fields producible. The weights of the moving element for laboratory standard instruments are greater than for the corresponding portable instruments.

The moment of inertia of electrodynamic instruments is much higher than for the other two types; this is due in part to the greater weight of the moving element and in part to the greater diameter of the moving coil as needed to aid in torque production. Although the weight of the element is usually the same for low and medium capacities, the low-capacity instrument presents difficulty in developing the requisite torque. There is therefore in general a sacrifice in the ratio of torque to weight, a ratio which serves somewhat as an index of ruggedness if not of sensitivity. The laboratory standard instruments have a higher ratio of torque to weight than the corresponding portables.

The damping of permanent-magnet moving-coil instruments is readily brought to the most effective point, i.e., 70 to 80 per cent of critical damping with an "overshoot" of 1 to 3 per cent. The damping torque of electrodynamic and moving-iron instruments is of the same order of magnitude as in permanent-magnet moving-coil instruments, but the "per cent of critical" is lower, due to the influence of the high values of moment of inertia in offsetting the lower values of restoring torque of the control spring.

In the case of millivoltmeters used with shunts to form an ammeter combination the instrument resistance is a single value for all current ranges in a given type. The shunt has a resistance inversely proportional to the current rating, thus creating a uniform value of volts-drop at all the rated capacities. On the other hand, the resistance, inductance and impedance of electrodynamic instruments vary approximately inversely as the square of the rating; thus low-range instruments inevitably have high impedance and large voltage drops. For this reason practically no gain in accuracy is acquired by substituting a 1-amp. ammeter for a 5-amp. meter connected through a current transformer to indicate current values below the 1-amp. mark on the 5-amp. meter scale unless correction is applied for the greatly increased ratio and phase-angle error of the transformer resulting from the greatly increased burden on it. Step-up ratio current transformers are available for measurements of such magnitude.

Watts dissipated in heating the shunt of a d.c. ammeter are proportional to the current rating. Large capacity shunts should therefore be well ventilated to dispose of the higher losses. In all but the very low ranges the resistance of d.c. voltmeters is of the order of 100 to 200 ohms per volt. Impedances of a.c. voltmeters are about one-tenth to one-twentieth the resistances of the corresponding d.c. meters and consequently their draft of current from the line is ten to twenty times as great as in the case of the d.c. meters. Failure to observe this point often leads to erroneous power-factor determinations in condenser tests and also faulty values in resonance studies. Double range a.c. voltmeters, as a general rule, draw more current from the line on their upper range than do corresponding single range instruments.

Typical Instruments

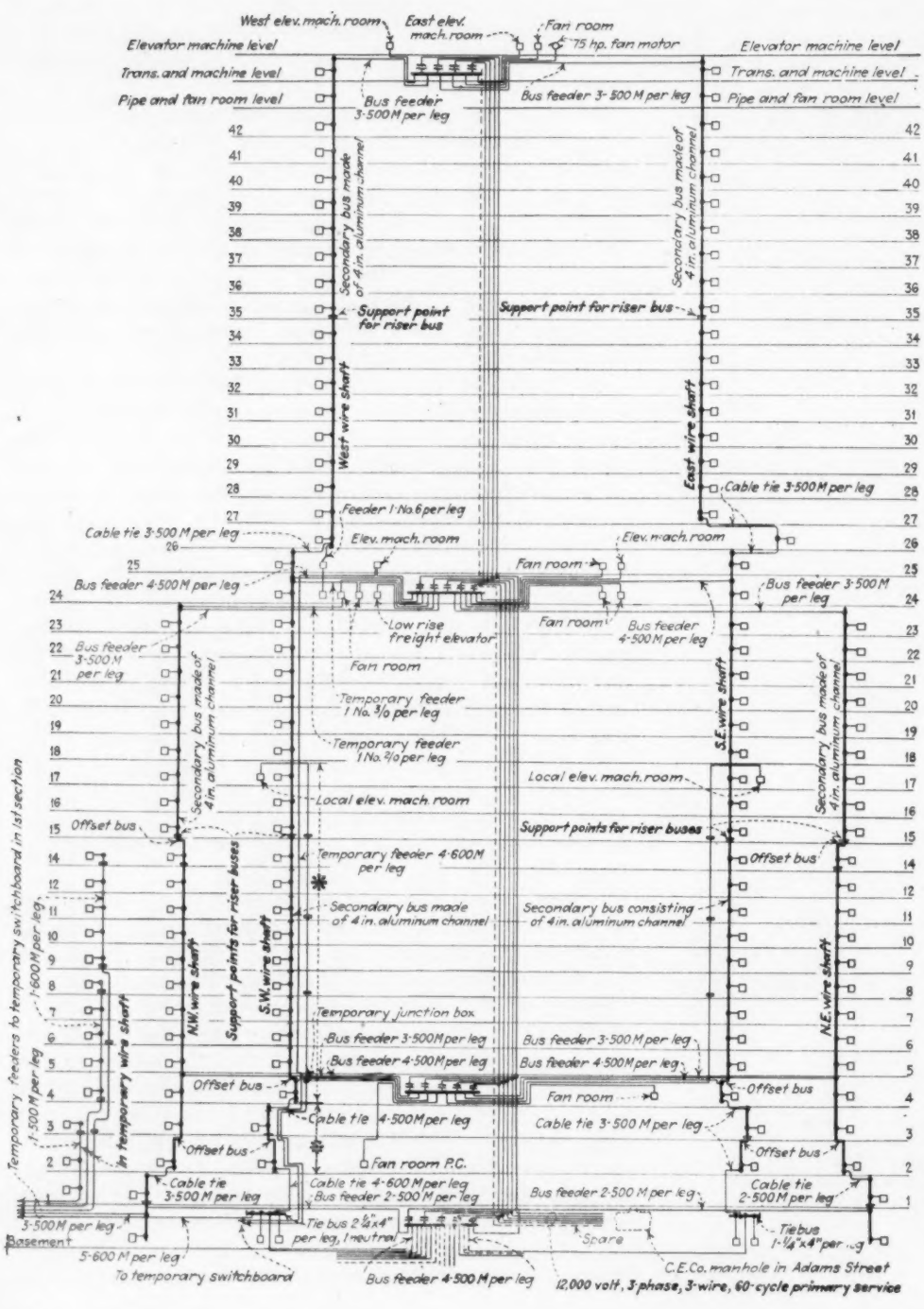
Voltage Circuit						Current Circuit			
Resistance in Ohms			Inductance, Mh.	Full Scale		Resistance Ohms	Inductance Mh.	Full Scale	
	Copper	Total		Amps.	Watts			Volts	Watts
	1.3					1.33		0.200	0.030
	1.3					0.04		0.200	1.0
	1.3					0.0004		0.200	100
	0.27			0.05					
								0.169	0.000051
						0.010		0.05	0.25
						0.00010		0.05	25
	1.7	6.0		0.00333	66.7×10^{-6}				
	14.0	15,000		0.010	1.5				
	1.3	2.0		0.025	0.00125				
	14.0	30,000		0.005	0.75				
	9.0	3,000		0.005	0.075				
		2		0.005	0.00005				
		300		0.010	0.03				
		15,000		0.010	1.5				
						0.4	0.07	2.0	10
	1.6					48	45	12.7	3.0
		1,770	65	0.085	6.37				
	135	2,030	67	0.074	11.1				
	24	1,200	24	0.125	18.7				
	3.71	4,500	134.0	0.0333	5				
		3,340	3.4	0.045	6.75	0.029	0.039	0.14	0.75
		2,630	3.4	0.019	0.95	2.82	4.7	1.41	0.71
		6,820	3.4	0.022	3.3	0.64	0.95	0.64	0.64
		4,170	4.1	0.036	5.4	2.82	4.7	2.82	2.82
	400	8,000	11.2	0.0125	1.25	0.0548	0.016	0.28	1.37
	85	5,500	5	0.0182	1.82	0.09	0.11	0.50	2.2
	58	2,360	2.5	0.0424	4.24	0.09	0.11	0.50	2.2
						0.199	0.168		
						1,540	2,200	30.8	0.6
						0.044	0.091	0.217	1.1
						0.000054	0.000008	0.027	13.5
						0.056	0.10	0.34	1.4
		150	22	0.2	6				
		2,000	275	0.075	11.25				

...icated by bold face figures.

Chicago's First Network Is a Vertical One

Field Building, now being erected, pioneers a.c. network in heart of d.c. district. Vertical rigid buses of aluminum channel serve as secondary trunks.

By C. A. CARPENTER
Electrical Engineer
Graham, Anderson, Probst & White, Architects, Chicago


West elev. mach. room
East elev. mach. room
Fan room
75 hp. fan motor
Elevator machine level
Trans. and machine level
Pipe and fan room level
Bus feeder 3-500 M per leg
Secondary bus made of 4 in. aluminum channel
Support point for riser bus
West wire shaft
East wire shaft
Cable tie 3-500 M per leg
Feeder 1-No. 6 per leg
Elev. mach. room
Fan room
Bus feeder 4-500 M per leg
Bus feeder 3-500 M per leg
Low rise freight elevator
Bus feeder 4-500 M per leg
Temporary feeder 1 No. 3/0 per leg
Local elev. mach. room
Offset bus
Support points for riser buses
S.E. wire shaft
N.E. wire shaft
N.W. wire shaft
S.W. wire shaft
Temporary feeder 4-600 M per leg
Secondary bus made of 4 in. aluminum channel
Secondary bus consisting of 4 in. aluminum channel
Temporary junction box
Bus feeder 2-500 M per leg
Cable tie 4-500 M per leg
Cable tie 3-500 M per leg
Cable tie 2-500 M per leg
Fan room P.C.
Cable tie 4-600 M per leg
Tie bus 2-1/4" x 4" per leg, 1 neutral
Tie bus 1-1/4" x 4" per leg
Spare
Temporary feeders to temporary switchboard in 1st section
1-600 M per leg
1-500 M per leg
3-500 M per leg
Basement
5-600 M per leg
To temporary switchboard
C.E.Co. manhole in Adams Street
12,000 volt, 3-phase, 3-wire, 60-cycle primary service

PRINCIPALLY because its large new load would have necessitated very considerable capacity addition in an already heavily loaded area of the direct-current district which the Commonwealth Edison Company is serving, the new Field Building, the first section of which is now ready for occupancy, is supplied with alternating current. This building is the first within the Loop and the second in the city to have complete alternating-current supply in preference to available direct current. The other building, the Merchandise Mart, is one of very large floor area (two full blocks) and of comparatively low height (fifteen stories) and is served by radial secondaries from one substation

Chicago's first a.c. network

In order to simplify this riser diagram none of the connections to the temporary switchboard has been shown and connections from the permanent basement switchboard which are dead-ended are to be understood to serve power centers and isolated lighting cabinets which are not connected to the network system. The panels and cabinets utilized in the temporary southwest riser will be transferred, one by one, to the permanent southwest riser, according to the construction program.

Between the points indicated by the stars are installed two 4-in. channels for each phase and one 4-in. channel for the neutral. Beyond these points one channel of each phase and the neutral is continued throughout the remainder of the secondary bus riser in the southwest wire shaft. Secondary bus risers in the northwest, northeast and southeast wire shafts and the west and east wire shafts in the tower will consist of one 4-in. channel for each phase and the neutral.

approximately in the center of the eighth floor. This circumstance gives the Field Building the distinction of pioneering the secondary network idea in Chicago.

The new building faces south on Adams Street between Clark and La Salle in the financial district of Chicago and occupies a ground area approximately 320x190 ft. The main portion has three basements and rises to a height of 24 stories above the street. The whole is surmounted by a twenty-story tower. With a rentable area of approximately 1,000,000 sq.ft. it will be, when completed, one of the largest office buildings in Chicago.

On the basis of approximately 3 watts per square foot for rentable area and lesser values for public and utility spaces, the building will have a total connected lighting load of about 4,400 kva. The power load will amount to approximately 5,600 hp. connected. Assuming full occupancy of the building and utilization of facilities up to the maximum provided, the ultimate maximum demand for light is estimated at nearly 3,200 kva. and the maximum demand for power is expected to be about 2,400 kva., with a total electrical demand for the building, therefore, of about 5,600 kva. The power company serves the new building with 12,000-volt, three-phase, 60-cycle alternating current, transforming this primary supply within the building to the required low voltages.

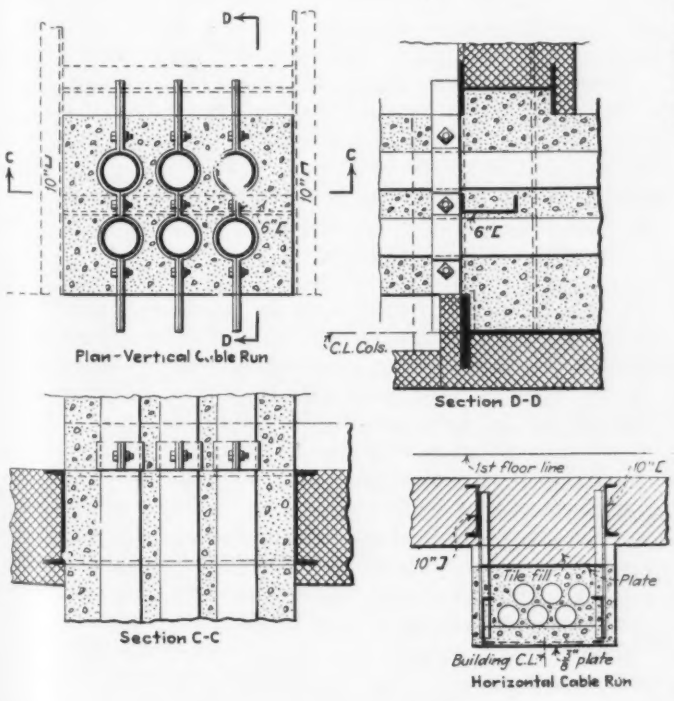
Sectional construction requires temporary riser

Two principal methods of transforming and distributing the electrical energy were available: First, by the use of a single transformer vault and switchboard in the sub-basement, with radial feeders for light and power extending upward through the building and, second, the installation of several transformer vaults feeding into a vertical a.c. network system. Considering the height of the building and the size of the load, the first scheme would obviously have been excessively expensive, therefore the second was decided upon.

On account of local conditions, it has been necessary to plan for the construction of the building in three sections. The first section is made up of the west, 90 ft.; the second comprises the next 42 ft. to the east, not including any portion of the tower, however; while the third section takes in the remainder of the building, including the tower. Since the third section will occupy more than one-half of the lot area and will include the tower, it was necessary to locate the permanent transformer vaults and high-tension wiring in that section in order that the points of service would be nearer to the center of load.

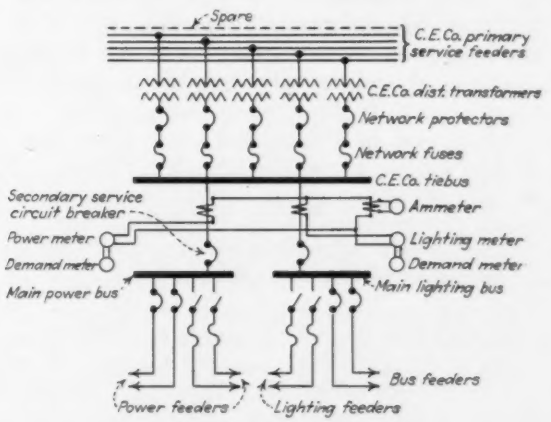
Therefore, arrangements had to be made for the installation of temporary service, with a temporary transformer vault and switchboard in the basement of the first section. This has been planned so as to serve the first and second sections and will remain in service until the substantial completion of the permanent high-tension riser and secondary network system. The temporary switchboard is located in a room immediately adjoining the transformer vault, and from this switchboard feeders have been taken to the permanent northwest and southwest riser shafts to furnish power and lighting supply for the first and second sections of the building up to and including the 25th story. Because the permanent southwest riser shaft is located in the second section of the building a temporary southwest riser had to be provided to serve the south half of the first section.

To accomplish this temporary service it has been necessary to feed the northwest and southwest risers from the bottom only. As indicated on the riser diagram, the temporary southwest riser is of cable and conduit construction arranged in three sections and terminating on the fourteenth floor, which is the temporary upper limit of occupancy in the first section. It will be possible temporarily to care for the requirements in the northwest and southwest sections of the building by feeding the risers at the bottom only, on account of the



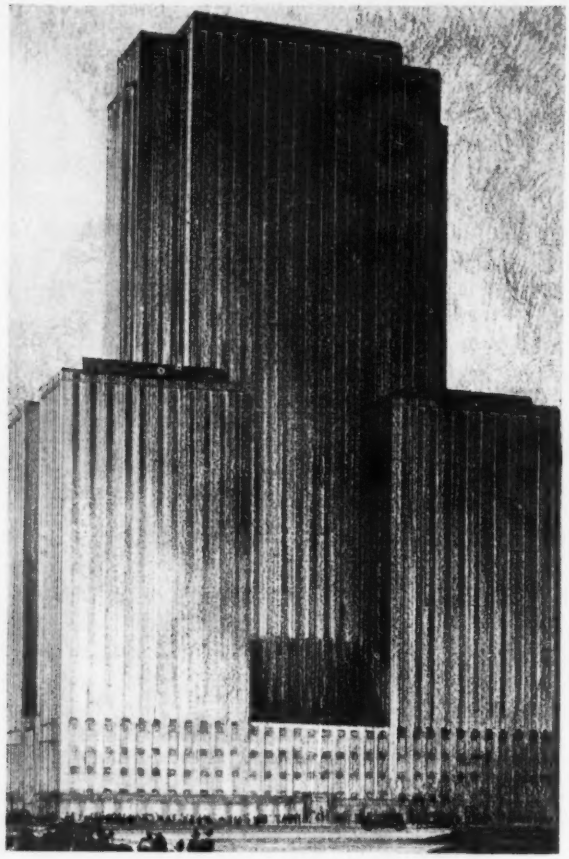
High-voltage service cables incased in concrete

In order to provide additional protection against encroachment from above and below, and to comply with municipal requirements, ½-in. steel plates will be provided above and below the concrete, full width and length of the horizontal service run. These plates are expected to act as armor to prevent any drilling or cutting operations which may pass through the first floor construction or furred ceiling beneath from encountering the concrete conduit inclosure.



Typical service connections

In the Field Building the utility company owns and maintains all service equipment up to the distribution buses. Metering is between the tie and distribution buses.



How Chicago's new Field Building will look

The west section is now erected and occupied. This is substantially the part on the left up to the drop in the center. Demolition of an old building is now in progress for construction of the second section. The third construction will include the east half and the tower, practically two-thirds of the completed structure.

limited electrical demands, until the building is completed. This will be changed for the ultimate installation.

Concrete protection for 12-kv. cables

The permanent high-tension service will enter the front of the building at approximately its midpoint. No service switches, breakers or disconnects of any character are to be installed at this point. A manhole will be constructed in the street, immediately against the curb wall, and the building service conduits brought through the latter and extended into the manhole. These will comprise six 3½-in. steel conduits, which will be carried across the basement, suspended from the first floor structure and above a suspended ceiling. These conduits will be incased in a concrete inclosure having a minimum thickness of 3 in. around conduits. This entire structure will be carried by hangers from special framing provided in the first floor construction of the Field Building.

The ultimate installation contemplates bringing in five three-phase primary feeders, leaving one conduit empty, as shown on the riser diagram. However, owing to the fact that it is anticipated that the maximum demand will not reach the values previously given for a number of years to come, the power company will install initially only four high-tension service lines, which will be extended the entire height of the building. It will be noted that the number of transformers and primary feeders indicated on the riser diagram represents the ultimate arrangements. Of the four feeders to be installed, two will come from a substation west of the building and two from another on the east. In this way any extraordinary underground disturbance resulting in complete interruption of service in one of the streets traversed by high-tension feeders to this building will not result in interruption of service, as the other two feeders will be ample to take care of the total building requirements. In the same way one of the feeders may go out of service through accidental causes, while another feeder is temporarily removed from service for maintenance work, without materially interfering with the electrical supply to the building.

Unbroken conduit lines

The horizontal high-tension service run across the basement will terminate in the basement transformer vault. From this connections will be taken directly up to the fourth-floor vault. From the latter, similar connections will be taken to the 24th- and 44th-floor vaults. From any vault to the one above the conduit run will be unbroken. Conduits and their supports will be arranged as indicated in the drawing here reproduced.

The high-tension shaftway is plumb throughout the building, except where a slight offset is necessary in passing from the 24th to the 26th stories. The location of the high-tension shaft was dictated principally by the necessity of maintaining alignment and placing it in such position as would minimize the possibility of encroachment on account of building maintenance operations. A third factor influencing the selection of its location was that transformer vaults and switchboard rooms, the former of which must of necessity immediately adjoin the high-tension shaft, should be located where building space has a minimum rental value. The reason for the location of vaults in the basement, 24th and 44th stories is obvious. The fourth-story vault is so placed because of an expected considerable additional power load due to extensive air-conditioning equipment to be installed at a later date, as well as to relieve the vaults above and below of a portion of their loads.

Vaults are mechanically ventilated, each being provided with its individual fresh air fan. One exhaust fan takes care of the three lower vaults and a separate exhaust fan serves the 44th-floor vault. The ventilating system is so arranged that breakdown of an exhaust fan or fresh-air fan will not cripple the operation of the vault with which it is connected.

Contrary to practice in some other tower buildings where multiple transformer vaults have been installed, the high-tension cables in the Field Building will be furnished and installed by the electric utility. The type of high-tension cable to be used in this building has not yet been definitely determined by the Edison company. The power company will provide in each vault an initial installation of four 450-kva., three-phase, 208/120-volt transformers and a like number of network protectors, one for each of the high-tension feeders entering the vault. Provision will be made for future installation of a fifth transformer and network protector in each of the three lower vaults, as may be required later.

The "typical service connections" illustrate the general arrangement of high-tension feeders, transformers,

network protectors, buses and feeder connections thereto. In order to secure the maximum possible benefit from diversity between light and power demands, the Commonwealth Edison Company has arranged to tie together the load ends of its network protectors by means of a common bus. In order to facilitate metering, the load is divided into light and power sections beyond the limits of the tie bus.

With the single exception of the actual metering equipment, all construction beyond the tie bus is part of the work of the building contractor. The tie bus and all construction and apparatus on the service side of same is the work of the Commonwealth Edison Company.

A novel feature of the secondary network is the use of rigid aluminum channel for the vertical risers. As shown on the riser diagram, there are six of these risers (four buses actually, since the two in the tower are continuations of two in the main bulk of the building), each one of which is supported only at one point, its approximate center. The single supports, possible because of the light weight of the aluminum, simplified the design and reduced the cost. Because of the bus expansion and contraction both ways from the center, taps to cutout cabinets and other connections are made with flexible conductors. The use of these aluminum risers brought up a number of design and installation problems whose solutions were reached in rather novel ways. These features of the Field Building electrical distribution will be discussed in a following article.

▼ ▼ ▼

Stress Problems Overcome in Cemented Insulators

By E. H. FRITZ

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IT HAS been generally understood that pin-type insulator failures, comparatively frequent some years ago, were almost entirely due to the stresses placed on the porcelain by the cement used in joining the porcelain parts. These stresses had their sources in the higher coefficient of expansion in cement as compared to porcelain and the fact that cement undergoes an increase in volume when it absorbs moisture from the atmosphere. For a time it was also thought that there was a gradual, permanent expansion or growth in the cement due to chemical changes, but thorough investigations proved this to be false. The only changes in volume which cement undergoes are those due to temperature changes and the absorption of moisture by the cement. These volume changes are not permanent, the volume increasing and decreasing directly with the temperature and with the moisture content. Use of resilient coatings between the porcelain and cement and employment of cement mortar rather than neat portland cement have reduced these stresses sufficiently to prevent failure of the porcelain.

To evaluate more definitely the effectiveness of these improvements and also the effect of the porcelain shape employed an investigation was carried on over a number of years, the results of which prove definitely the correctness of present design and construction. The investigation can be divided into two parts: The first studied the behavior of the cement with and without resilient coatings on the porcelain and with changes in the cement itself, using the same porcelain design throughout. The second part studied the effect of changes in the porcelain design, considering particularly the angle of slope between two porcelain parts cemented together, as found in a multipart pin-type insulator.

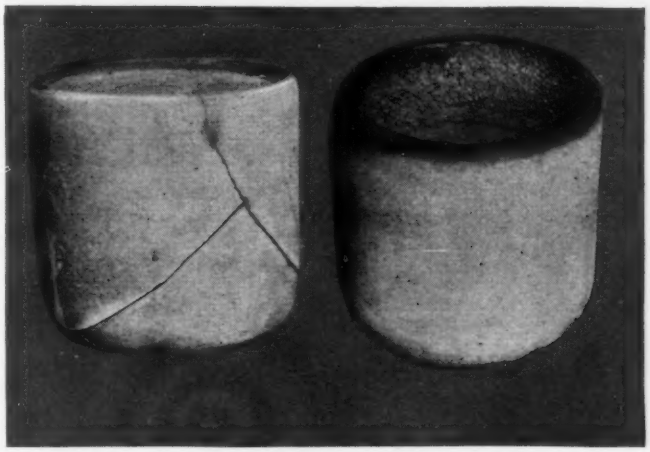

Fig. 1—Thin walls of porcelain test cup exaggerate cement stresses

Cups filled with neat Portland cement.

For the first part of the investigation a porcelain test cup was designed, having an outside diameter of 3½ in., an outside height of 3½ in. and ¼-in. walls. The thin vertical walls and comparatively large mass of cement required to fill the cup exaggerated the stress conditions prevailing in commercial pin-type insulator designs, and consequently accelerated the failures of the test pieces (see Fig. 1). The inside of the cup was sanded to duplicate gripping surfaces used on insulators and the cups were filled with cement, with and without the use of resilient material between porcelain and cement. After the usual curing process for the setting of the cement the cups were placed on the roof of a building, where they were exposed to all weather conditions. Various brands of standard portland cements found on the market were studied, the results being practically similar for the various suppliers.

Performance of these cups filled with neat portland

cement, with and without resilient material, is shown in Fig. 2. It required but 345 days for the entire lot of cups to fail, having no resilient material, as compared to 1,395 days for those having resilient material.

Mortar versus sand

The effect of using a mortar consisting of 50 per cent each of cement and sand as compared to neat cement is shown in Fig. 3, resilient material being employed in both cases. At the end of 1,395 days, when all of the cups having neat cement had failed, 40 per cent of the cups filled with martor had failed, and at the end of 1,800 days, when the investigation was discontinued, only 45 per cent had failed. This indicated strikingly the cumulative improvement of the two changes from the original condition of neat cement and no resilient material.

For the second part of the investigation a series of double cups, one nesting within the other, was designed having excessive space for cement and relatively thin porcelain walls. The slope of the sides of these cups varied between 0 deg. and 25 deg. from the vertical. These designs are shown in Fig. 4. These cups were assembled with and without resilient material between cement and porcelain, also with neat cement and with the 50 per cent cement-mortar, and exposed to the weather similarly as the other cups. Fig. 5 shows a definite increase in failures as the slope is decreased below 15 deg. Increasing the angle above 15 deg. apparently has no effect on the results. These results are logical, since slopes somewhat away from the vertical reduce the tensile stress component on the porcelain when the cement expands.

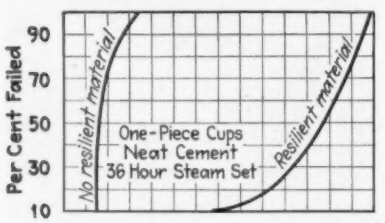

Fig. 2—Effect of resilient material on failure of porcelain test cups

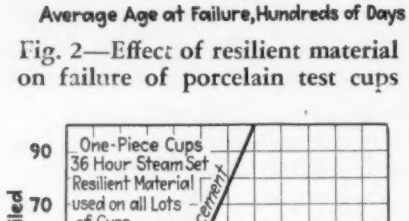

Fig. 3 — Relative effects of neat cement vs. mortar on porcelain test cups

The mortar consisted of half cement and half sand. Resilient material was used between porcelain and cement or mortar.

The effect of the changes in assembly procedure considered in the first part of this investigation resulted as follows: 25 per cent of the cups represented by Fig. 5 were assembled with 50 per cent cement-mortar and the remainder with neat cement. This disregards whether or not resilient coatings were employed. Slightly more than 60 per cent of all of the cups had failed when the investigation was discontinued, and only 13 per cent of the failures were mortar assemblies. In other words, 25 per cent of the cups, or the portion assembled with mortar, produced but 13 per cent of the failures, indicating again the advantage of the use of mortar.

The effect of resilient coatings in the cups assembled with 50 per cent cement-mortar in this particular investigation again was very definite. Only 2 per cent of those having resilient coatings failed, while 60 per cent of those without these coatings failed. In other words, using a 50 per cent cement-mortar, more or less sloping the sides of the test cups, and using resilient coatings between mortar and porcelain results in practically no failures over the entire period of the investigation, or almost five years.

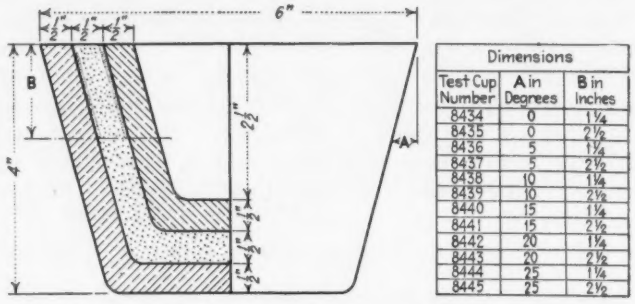

Fig. 4—Design of porcelain test cups for cement study

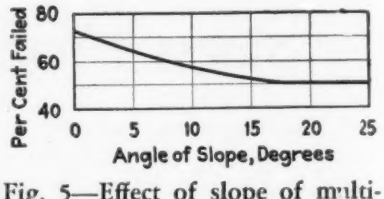

Fig. 5—Effect of slope of multipart porcelain test cup on failure

The per cent failed is the average of all results obtained with each particular slope studied, regardless of the method of assembly; i.e., whether with or without resilient coatings or whether cement or mortar was employed.

The investigation shows conclusively the value of the resilient coatings, the improved results from the use of 50 per cent cement and sand mortar and the desirability of maintaining a slope in the nested sections of a multipart pin-type insulator of 15 deg. or more from the vertical. Stress conditions in commercial designs are more favorable even than in the nested test cups because the porcelain walls are thicker, the cement section thinner and because the sheds of the insulator provide additional resistance for these stresses. Considering the fact that only 2 per cent of the test cups employing all of these improvements failed, it is safe to conclude that pin-type insulators employing these improvements should show no deterioration on account of the cement. Performance of multipart pin-type insulators in recent years is giving proof of this.

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READERS' FORUM

Air Comfort

To the Editor of the ELECTRICAL WORLD:

Allow me to draw your attention to page 1100 in the issue of June 25, 1932, the second column, the thirteenth line from the bottom: The figures "80" and "78" are apparently reversed. The effective temperature cannot be less than the wet bulb temperature, and as I read the chart these figures should be reversed.

601 Franklin Building,
Philadelphia.

H. GOODWIN, JR.,
Consulting Engineer.

Men of the Industry

W. W. Crocker has been elected a director of the Pacific Lighting Corporation to succeed Garrettson Dulin, resigned.

•

A. Augustus Low, a vice-president of the Utica Gas & Electric Company, has been elected a member of the board of directors and Leonard Whistler has been made treasurer and a director.

•

W. H. Sammis of New York has been elected a director of Consumers Power Company, Jackson, Mich. Mr. Sammis was formerly located in Jackson, the general offices of the company.

•

Fletcher D. Hallock, who is connected with the Westinghouse Electric & Manufacturing Company, was elected chairman of the Boston section of the American Institute of Electrical Engineers at the recent annual meeting.

•

D. G. Volkman of San Francisco has been elected a vice-president of the Pacific Lighting Corporation. Mr. Volkman is a director and a member of the executive committee of the board of directors of the company.

•

Harry J. Bauer, attorney and a director of the Southern California Edison Company, Ltd., since 1917, has been elected chairman of the board of directors of Claude Neon Electrical Products Corporation, Ltd., to fill the vacancy caused by the death of John B. Miller.

•

George E. Jaquet, formerly connected with the Society for Electrical Development, is now secretary of the Connecticut Utilities Merchandising Company, Branford, Conn.

•

R. V. Somerville, assistant to the president of Claude Neon Lights, Inc., and president and director of the Claude Neon Strauss Corporation, vice-president and director of Strauss & Company, director of Claude Neon Lights of Maryland, Inc., has severed his connections with the above companies. Mr. Somerville will conduct a consultant service with headquarters in Carnegie Hall, New York.

•

W. R. Thorson, formerly connected with the engineering department of the Consumers Power Company at Jackson, Mich., is now superintendent of public works, Waverly, Iowa. Mr. Thorson first joined the Consumers Power organization in 1925 in the distribution engineering department. Subsequently he was transferred to Kalamazoo as district engineer and then to Hudson as superintendent of electric distribution. When this territory was made a part of the Jackson district, he returned to Jackson as a member of the district engineering department.

•

Hon. Lewis Goldberg, formerly a commissioner of the Massachusetts Department of Public Utilities, has been nominated to a Superior Court judgeship by Governor Ely.

▼

J. W. Hancock Heads Southeastern Division

John W. Hancock, manager of the Appalachian Electric Power Company, Roanoke, has been elected president of the Southeastern Geographic Division of the National Electric Light Association. Soon after his connection with the electrical industry Mr. Hancock became general manager of the Roanoke Railway & Electric Company, and later also of the Lynchburg Traction & Light

Company, controlled by the same interests. In 1925 these and a number of other electric companies in southwest Virginia, West Virginia, eastern Kentucky and eastern Tennessee were acquired by the American Gas & Electric Company, and it formed the Appalachian Electric Power Company. Mr. Hancock was placed in charge of the Roanoke-Lynchburg division.

Long convinced that rural electrification offers one of the surest and most satisfactory solutions to the farmers' agricultural problems, he has devoted much time to a study of the best, simplest and most economical methods of its development. Mr. Hancock is a member of the American Institute of Electrical Engineers, the National Electric Light Association and has served several terms as president of the Public Utilities Association of Virginia.

J. P. Clayton Named Chief System Officer

J. Paul Clayton has been made chief system officer for the interconnected electric system of the Commonwealth Edison Company, the Public Service Company of Northern Illinois and affiliated companies, effective September 1. The chief system officer will co-ordinate all system activities for the mutual advantage of the companies. The creation of such a supervising and co-ordinating agency will not affect the operating organizations of the respective companies and will not alter the functions and responsibilities of their present officials.

Mr. Clayton has a long record in the electricity supply business in Illinois. From 1919 to 1932 he served as vice-president of the Central Illinois Public Service Company, and since April of this year has been president of that company. Since January 1, 1928, he also has been assistant to the president of the Super-Power Company of Illinois (Powerton station). Early in the year he retired from this position to become vice-president in charge of operations of Middle West Utilities Company. He will resign his connection with the Middle West system to devote his exclusive attention to his new work.

▼

Dr. Jacob Pieter Den Hartog, recently chief of the dynamics section, Westinghouse Electric & Manufacturing Company research laboratory, has been appointed assistant professor of applied mechanics in the Harvard Engineering School, Cambridge, Mass.

•

W. J. Baldwin, for ten years public relations director of the Alabama Power Company and Commonwealth & Southern Corporation with offices in Birmingham, has transferred his interests to Greenville, Ala., to become advertising manager of Greenville Products Company, manufacturer of a mineral water preparation.

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OBITUARY

Dr. Wilhelm Peuhert, an Austrian authority on accumulators, electrical measurements and high-frequency currents, died recently in Vienna at the age of 77.

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Dr. Walther Mollier, managing director of the Austrian Siemens-Schuckert Works, died recently in Vienna at the age of 57. Dr. Mollier had been associated with the Siemens undertakings for more than 30 years. He was considered an authority on electric locomotive construction.

New Equipment Available

Westinghouse Redesigns Fractional-Hp. Motors

Complete revision of its line of fractional-horsepower motors is announced by O. E. Stroman, manager industrial department of Westinghouse Electric & Manufacturing Company. An entirely new type of capacitor motor and the redesign of the older types of other small motors are elements of improvements which took more than a year to develop and required considerable investment.

A degree of interchangeability heretofore unapproached in small motor manufacture is said to have been achieved in the new Westinghouse designs. Frames, shafts, bearings and mounting arrangements are interchangeable, rating for rating. Five frame sizes suffice to serve the entire line, ranging in output from one-thirtieth to three-quarter horsepower, whereas more than a hundred frame sizes were formerly required.

All types of small motors are affected by the redesign. Split phase, capacitor, repulsion-induction, polyphase, direct current and repulsion motors will comprise the new line.

First to be put into production is the capacitor type motor, used in refrigerators, oil burners and stokers. Production on the other types of motors will be started as soon as changeovers in shop equipment are completed.

A feature of the new motors is an improved type of resilient spring mounting. It nullifies the vibration inherent in all 60-cycle alternating-current motors—vibration which results from the current changing its direction 120 times each second.

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Aluminum Cone Improves in Masonry Anchor

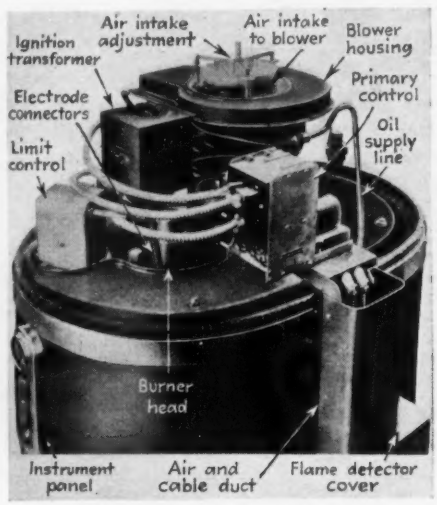
One-piece, heavy-duty, double-expanding masonry anchors for bolts, departing from usual construction in that a double inverted cone body of aluminum is employed as the expanding factor, which, it is said, gives greatly increased holding power, are announced by the Rawlplug Company, Inc., New York.

Among the features are: One-piece fool-proof construction—no top or bottom—either end may be inserted in the hole; when properly calked at a sufficient depth a single Rawl-Anchor will develop the entire strength of the bolt or surrounding material; as only one unit is used for any size bolt, there is but one calking operation needed; the ductile aluminum collars top and bottom spread upon being calked and completely seal the hole, preventing the lead from "flowing" under a load pull; the bolt will not turn in the hole as the bolt head imbeds itself in the ductile aluminum collar when calked.

▼

Oil Furnace with New Combustion Principle

A new principle of combustion is employed in the new oil furnace announced by the General Electric Company. The furnace is designed for use primarily in homes and comprises a co-ordinated boiler, burner and control, designed and manufactured as one unit. Its maximum output is 257,000 B.t.u. per hour. The co-ordination in design of the combustion space and boiler surface with



the burner capacity assures high efficiency and economical operation.

Finely divided particles of oil are blown from the nozzle under air pressure and are directed toward the bottom of the furnace. A small amount of air, fed in around the nozzle, cools the nozzle and the electrodes and starts the combustion at a point some distance below the nozzle. The greater part of the air supply, however, is taken from the blower of the oil burner through a duct at the left side of the furnace and enters the bottom of the combustion space, directed upward.

The burner motor has no brushes to require maintenance. The control and the oil burner unit mounted above the boiler are inclosed under a tightly fitting cover. The thermal control is an electrically operated combined time switch, clock and thermostat, inclosed.

Synchronous Motor for General Purposes

A synchronous motor which has been developed for industrial and general purpose applications is announced by the Ideal Electric & Manufacturing Company, Mansfield, Ohio. The "Self-Syn" motor is a compact, self-excited, self-synchronizing, self-contained motor unit that requires no external excitation, the exciter windings, direct-current commutator, etc., being integral with the motor itself. Since no field switch or complicated synchronizing relay is necessary, this motor is started with a simple hand-operated compensator in the same manner as an ordinary induction motor. These motors are supplied in all sizes from 5 to 100 hp. at 900, 1,200 and 1,800 r.p.m.

▼

Mill-Type Starters for General-Purpose Use

Utilizing newly developed accelerating contactors designed not only to act in the capacity of a relay to provide time delay, but also to short out the starting resistor by means of a contact finger, a new line of general-purpose mill-type starters for constant-speed, direct-current motors has been developed by the General Electric Company. The new accelerating contactor replaces two conventional devices; namely, the accelerating relay and the old accelerating contactor. These starters are sturdy, and embody unusual mechanical and electrical simplicity, thereby cutting maintenance cost to a minimum. The accelerating contactors are equipped with silver-faced tips so as to eliminate oxidation difficulties in instances where the motor operates steadily for long periods.

The new general-purpose mill-type starters are available in sizes from 1 hp. up to 75 hp. Each starter mounts the following devices: line contactor, equipped with interlock for undervoltage protection (when used with momentary contact start button); magnetic time-accelerating contactors; thermal overload relay; starting resistor, and, sheet metal inclosing case, ventilated, adapted for wall mounting.

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AN AIR-BREAK TYPE of direct-current explosion-proof, across-the-line, manual control, approved and rated "permissible" by the U. S. Bureau of Mines, and differing from previous designs, is announced by Cutler-Hammer, Inc., Milwaukee, Wis. These two-pole starters have thermal overload and low-voltage protection and are rated 4 hp. at 230 volts, and 5 hp. at 550 volts. A main line fuse is built directly into the case, which is made of cast iron and has a screwed-on cover.